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INDEX TO CONTENTS, PAGE 209. - - - - - - - ADVERTISERS' INDEX, PAGE 22.

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CONTENTS.

An Asterisk (*) Denotes an Illustrated Article.

Calorific Value of Expressing the True Quality of Gas and Conditions Governing the Supply, by Mr. J. B. Klumpp..... 209
Forty-fourth Meeting, New England Association of Gas Engineers—[Official Report—Continued from Page 134]..... 212
First Day, Morning Session—Discussing the Paper by Mr. C. A. Learned, on "Notes on Vertical Settings in English Works,"
EDITORIALS—
Briefly Told 216
"All Aboard for Mobile!"—Ready to Start National Advertising—To Develop Mineral Resources—Industrial Gas Calorimetry—Joint Meeting, New England Section, National Commercial Gas Association, with Illuminating Engineering Society—Fire Brick in Retorts—Submarine Coal Fields Cape Breton—Current Mention.
*The Installation of Cast Iron Mains, by Walton Forstall—Continued from Page 198..... 218
Suggestions for Rate Making, by D. W. G. Raymond..... 220
The Eye as a Judge of Uniform Illumination, by J. R. Cravath.... 221
NEW METHODS AND APPLIANCES..... 222
*A Safety Set Screw—Spraying Molten Metals.
Recent Patent Issues..... 222
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 222
Death of Mr. James Sheldon Cummins—Something from Westboro, Mass.—Something from Lykens, Pa.—Sale of the Rocky Mount (N. C.) Bonds—Personal—And Some Others—The Emeritus Roll, Baltimore—Mr. Barthold Sails for Bermuda—A Verdict for a Florist—An Interesting Damage Suit—Successful 'Lamp Sale," Scranton, Pa.—The New Britain (Conn.) Company's Men Enjoy Themselves—Annual Meeting, Oswego, N. Y.—A Huge Gasholder—Something from Portland, Ore.—Personal—And Other Items.
UTILITIES COMMISSION NEWS..... 224
Secretary Illinois Commission—Authority Over Securities—Ohio Companies Must Test All Meters—Right of Community to Enjoy Its Natural Advantages—California Commission Definitions.
The Market for Gas Securities..... 224
Public Lighting Table for April, 1914.....(Advertising Section)... 10
Meeting Times of the Various Gas Associations " 27

Calorific Value of Expressing the True Quality of Gas and Conditions Governing Its Supply.[1]

[Prepared by MR. J. B. KLUMPP, Secy. Public Relations Committee, American Gas Institute, for the Indiana Gas Association, March, 1914.]

The recent enactment, by the Public Service Commission of the State of Indiana, of rules regulating the quality and supply of illuminating gas, has prompted the preparation of a paper which will bring out some of the more important points and emphasize some of the conditions which have a direct influence on the manufacture of gas under a calorific standard. These conditions are particularly important at this time because the operation of some of your properties must necessarily be changed to conform with the prescribed standard, and in some plants will tend to increase the cost of manufacturing and supplying the gas.

In order to bring out some points relating to the most economic standard of gas quality, and to emphasize their influence on conditions in Indiana, it may be well to give a short historical summary of the development of the gas industry, with special reference to the changes in the quality of the gas supplied.

1. Slightly abridged.—EDS.

When gas was first produced by the destructive distillation of coal the crudeness of the apparatus, and inefficiency of the lighting appliances, resulted in a costly illuminant of poor quality. However, there was no complaint that the flames did not give sufficient illumination, as everybody was surprised that the so called "inflammable air" gave any light whatever. As the commercial possibilities of the process were recognized, gas lighting became generally adopted throughout Europe and this country. In America, all of the large eastern cities adopted gas lighting in the first 40 years of the 19th century, and the incorporation of a company in Indianapolis (1852) marks the introduction of gas in Indiana.

The great growth of the gas industry, and experience and experimentation of those engaged in it, resulted in improvements in apparatus, in operating practice, in methods of distribution and utilization, which resulted in an improvement in the quality of the gas, with a coincident reduction of its cost to the consumer. Much experimental work was done, with the object of improving the types of installations, and to enable them to use the various grades of gas coals discovered. Every effort was made to better operating efficiencies, in order to reduce the cost and the selling price, and increase the business. These experiments and improvements, covering a long period of time, were based on the actual operation of many properties. While experimenting it was still necessary to supply gas at all times, and no doubt the quality was variable and frequently below normal. Had stringent restricting regulations been enforced during this time, based upon the normal or best quality of gas then made, many of these improvements and economies would undoubtedly have been retarded, if not altogether prevented. Their absence stimulated operators to adopt every improvement, and to make every effort to better the efficiencies of their installations. It permitted old installations to be scrapped and improved systems to be erected in their place.

The most important improvement in gas manufacture to make its appearance in the 19th century was the carbureted water gas process, introduced in Phoenixville, Pa., about 1873. With the commercial adaptation of this process, the manufacture and distribution of gas for illuminating purposes received a new impetus. The principle had been known for some time, and the discovery of petroleum in large quantities, with a decrease in the price of its products, made available an agent to give luminosity to the non-luminous water gas. It was through the development of the patent of Prof. T. S. C. Lowe that this system of gas manufacture was placed on a commercial basis. The advantages of the carbureted water gas process over the older coal gas process were: Low cost of apparatus and operation, flexibility of operation, freedom from by-products (they were often difficult to dispose of), with the possibility of making a gas of any desired illuminating value within reasonable limits, and higher than that of coal gas. The supply of cheap oil brought the cost of carbureted water gas down to a figure that resulted in a wide-spread introduction of this process, both in towns already supplied with coal gas plants and in others previously considered too small to maintain a gas works, and the system made enormous strides during the 80's and 90's.

Previous to 1880 gas was practically used solely for illumination with open flame burners, and its quality was properly measured in terms of candle power. The ease of enrichment inspired operators to supply a water gas of high illuminating value, in order to better compete with coal gas installations, and to make gas lighting more attractive, hence a stronger competitor of electric lighting, then mak-

ing its appearance. Not until after 1890 was much gas used for purposes other than illumination in flat flames, but about that time the perfecting of gas stoves, gas water heaters, and gas industrial appliances, caused the quantity of gas sold for cooking, heating and industrial work to increase so rapidly that it soon exceeded that sold for illuminating. In the field of illumination the invention and perfection of the incandescent mantle burner furnished a lighting med ium, which, to a large extent, replaced the open flame, and this burner, giving from 4 to 8 times as much light per cubic foot as the open flame, is not dependent for its efficiencies upon the illuminating value of the gas.

As the value of gas for heating purposes was recognized, the bunsen or atmospheric burner became more generally used, being necessary where the flame comes in contact with, or impinges upon, a cooling surface. In its use it became apparent that a gas of high illuminating value did not give as satisfactory service as one of lower candle power, and that when hydrocarbon vapors are present to a considerable extent, the difficulty of maintaining a perfect bunsen flame is increased. Unless the burner was exceedingly well designed, and provided for an ample supply of air, the combustion was incomplete, as with Welsbach burners when high candle power gas is used and any variation in quality or pressure occurs. In order to correct this trouble the candle power of the gas supplied was reduced. The high illuminating values were imparted to the gas by a percentage of hydrocarbons in excess of that which could be most efficiently used in Welsbach burners and other gas consuming appliances. With the realization that high candle power gas was not giving best service, and, with the consequent reduction in illuminating value which took place, a coincident reduction in calorific value was made.

About this time gas engineers began to appreciate that the illuminating value of gas no longer represented its true value to the consumer, but that its calorific (or heating) value did. Accordingly arguments were presented to regulatory bodies advocating that the standard of quality of gas be expressed in terms of its heating value, and several municipal bodies did establish such standards. Later, when State public utility commissions were established, their representatives confirmed the arguments presented by gas engineers.

The adoption of the calorific standard, as a regulatory order governing the quatity of the gas, has been a very wise move, since this property of the gas represents its true value to the greatest percentage of its consumption. At the present time all gas, except the very small percentage used in the open flame burner, is used as a heating agent, and its direct value is expressed in terms of its total heating value, in British thermal units per cubic foot.

Gas calorimetry has been thoroughly investigated by a committee of the American Gas Institute, and by the National Bureau of Standards, and it has been proved that with calorimeters of approved type operated according to directions, the results obtained will be correct within 1 or 2 per cent.; while readings of illuminating value may vary by as much as 50 per cent., depending upon the type of burner used, variations in the value of the standard, and the personal equation.

In changing from the candle power standard to the heating value standard now required, many operators are curious to know what relation exists between illuminating value obtained in the luminous flame burner, and heating value, and what calorific value corresponds to the candle power formerly supplied. Messrs. Dunbar and Davis have treated this subject in their able paper read before this Association in 1911, and proved that there is no definite relation between heating value and candle power, which has been corroborated by many recent experiments. However, for gases made by the same systems, those gases having the highest illuminating value have the highest calorific value. The relation of these properties depends upon the constituents of the gas. For instance, if the illuminating value is produced entirely by the addition of such a low hydrocarbon as marsh gas (CH_4), we expect a heating value of 200 to 250 B. T. U. for each candle; whereas if the illuminating value is obtained through the medium of ethylene, we may expect a heating value of about 25 B. T. U. for one candle. If we increase the illuminating value by means of benzol we will find an increase of from 6 to 8 heat units per candle power added. Candle power, here, means flat-flame candle power. These figures of enrichment are approximate, however, and are affected to a considerable extent by the remaining constituents of the gas. For instance, an additional 1 per cent. of carbonic acid (CO_2) will reduce the illuminating value of the gas by about 5 per cent., and the heating value by but 1 per cent.

The first State Utility Commission to specify a calorific value standard to the exclusion of the illuminating value, was that of Wisconsin, in 1908. At that time an investigation disclosed that the gas distributed in the State averaged over 600 B. T. U. per cubic foot, and, in order not to appreciably change the quality, the requirements were set at 600. At the present time the Wisconsin requirements are preventing the introduction of the more modern coal gas processes, through distributing unenriched, by-product, coke oven gas, and operating economies that would eventually be reflected in a reduction of price to the consumer. Several other States have followed Wisconsin's lead in adopting the heating value standard, and some have even adopted the same value. I believe, if these authorities had investigated the subject more fully, they would have appreciated that this standard restricted, to a considerable extent, the selection of gas generating systems, and of manufacturing materials. The Public Service Commission, Second New York District, realizing the importance of this, decided that an investigation of the prevailing conditions in that State would be a step towards the determining of the best standard of gas quality, and, therefore, solicited the co-operation of the engineers and operators of the State. The results of their 3 years' investigation have been published within the last year, and may be summed up in the followiug paragraph from the report:

"Taking all these conflicting factors into consideration, it is the judgment of the Committee that a total heat value, not exceeding 570 B.T.U., monthly average measured at the point where the gas leaves the manufacturing plant, corrected to a temperature of 60° F., and to a pressure of 30 inches of mercury, as measured by the rules of the Committee accompanying this report, is the standard which will best serve the interest of the people of New York State."

A perusal of this report will be of assistance in appreciating some of these facts, as a number of tests are given which show that unenriched coal gas, on the modern settings, cannot at all times be made of a heating value as high as demanded in Indiana.

Because the standard adopted in Indiana is that of Wisconsin and some other States, it was thought advisable to point out that a standard suitable to one locality is not necessarily suitable for another. The conditions controlling the methods of production and supply of gas may be very different from those existing in another State, and many of these conditions are not apparent to the layman, and sometimes not to the operators, until a thorough investigation of local conditions is made.

The factors which determine the method of manufacture to be used are numerous. First, the quality of gas required by the State or municipal regulations must be considered, as these often limit the systems that may be employed; second, the availability of supply of manufacturing materials and their cost; third, the opportunity for disposal of the by-products; fourth, the investment necessary. In addition local operating conditions may influence the operator in selecting the process of manufacture, such as load factor, labor conditions, etc.

Of these, all, except the State and municipal regulations, depend upon economic conditions. It is evident, therefore, that the regulatory bodies should so shape their orders that the manufacturer may be able to select those methods of manufacture which will enable him to make and deliver a serviceable gas at the lowest possible cost to himself, and, therefore, to the consumer. Any order that restricts the manufacturer prevents the highest economies being obtained.

We have spoken of the advantages and economics from the introduction of the carbureted water gas process, but within recent years conditions have changed very materially. During the past 10 years the demand for oil has increased enormously, with a steady increase in price, until the cost of carbureted water gas has, in many instaners, increased to such an extent that, even considering the other advantages, it cannot compete with coal gas. While new fields are being discovered, the demand is increasing at a rate that will greatly restrict the use of oil for gas purposes. Within a few years all the navies of the world will adopt oil burning vessels, and a method by which the heavy fractions of petroloum may be broken down into the gasolines, etc., may be discovered at any time. These factors, and the increased demand for heavy oils for processes that can pay prices prohibitive to the gas industry, tend to hasten the time when most of the gas manufactured will be coal gas.

In supplying coal gas, the location with reference to the supply of coal, and the availability of a market for by-products, are probably the two most important factors affecting the quality of the product, and the cost a manufacture. High freight rates, on the higher grades

of gas coals, will compel the use of poorer and more convenient low grades, resulting in gas of a lower quality. Where there is no profitable market for coke, for instance in the anthracite coal region, the manufacture of coal gas is necessarily prohibited. It is the demand for coke that makes a coal gas or coke oven plant a success.

The more modern methods of coal gas manufacture, such as the vertical, inclined and through-horizontal retorts, include designs for the economical recovery for all of the by-products, and have overcome most of the objectionable features that were apparent in the earlier processes. The handling of the coal and coke is now by some form of belt or bucket conveyor, thereby reducing the manual labor to a minimum; charging or discharging retorts is either by gravity or some mechanically operated device; the size of the carbonizing chambers has thereby been greatly increased, and the cost of operation lessened. The result is that the operating cost of the modern installation is materially less than that of the older processes, but this saving is partially offset by interest and depreciation charges on the greater investment.

With improved apparatus the yield of gas per ton of coal has been increased, and the heating value per cubic foot of gas slightly reduced. Experiments by Mr. Thomas Goulden, President, the East Counties' Gas Managers Association, presented in his presidential address, prove that, by increasing the yield of gas per pound of coal, a much greater total quantity of heat could be obtained in the gas. By reducing the heating value from 608 B.T.U. to 530 (a decrease of 12.8 per cent.), he was able to obtain 32 per cent. more gas, increasing the total heat delivered in the gas by 15 per cent. When it is considered that heat in gas is much more valuable than heat in coke, the economy of such operation is apparent. Besides lowering operating costs, by reason of extracting more heat per pound of coal, large yields reduce the total quantity of coke and other by-products and enable the operators to obtain a better price for them. All this shows that modern coal gas processes are economical, and their introduction should be encouraged by adopting a standard of heating value liberal enough to enable the gas produced to be distributed at all times without enrichment.

Another point to be considered in setting the standard is that, with the installation of large numbers of coal gas plants, the demand for gas coals will be greatly increased. The supply of high grade gas coal is limited, and any extraordinary demand will cause a rise in price. The United States Bureau of Mines, appreciating that the supply of such coals must soon become depleted, has conducted an investigation and showed that there are many coals somewhat lower in volatile combustible, which produce a satisfactory and serviceable gas, but a gas lower in heating value than that from the so-called "high grade gas coals." The reduction in cost possible by the use of these coals will often result in economies to the consumer in spite of a lower heating value. In order to enable operators to use such grades of coal, under the most economic conditions, the calorific regulations should be set lower than 600 B. T. U.

Another economical process which gas companies should be permitted to take advantage of is the by-product coke oven plant. Any locality which offers a large market for coke is suitable for such a plant, and if the present rate of increase is maintained the surplus by-product gas available for urban distribution will soon amount to a large percentage of all manufactured gas. In coke oven operation the kind of coke required determines to a large extent the quality of coal that may be used, and practically confines it to grades that produce coke suitable for furnace uses. Such a coal is not what we term a "high grade gas coal," having only 22 to 28 per cent. volatile combustible. The gas produced is not over 550 B. T. U., and under your present regulations could not be utilized.

In a number of places in this country coke oven gas is being supplied that has a high heating value, while in other cases the gas is much poorer. This difference is due to the type of ovens, the method of operation, and the treatment of the gas. When ovens were first installed in this country they all had a duplicate hydraulic main, by means of which the richer gases, or the first ⅓ driven off, were separated from the poorer or tail gases and for delivery to the gas company. This first fraction is high in heavy hydrocarbons or illuminants, has a high heating value, and its quality is easily controlled by varying the percentage of the gas selected for distribution, the remaining poorer gases being used for heating the ovens. In recent years many coke ovens installed do not thus separate the gases generated, the surplus gas sold for city supply being the run-of-oven, or a mixture of the poor and rich gases. Where ovens are so constructed the cost of the changes necessary for separation of the gases is prohibitive. If good grades of coals are used in such installations, the run-of-oven gas may be from 525 to 550 B. T. U., but under requirements 600 B. T. U., the use and sale of such gas are prohibited, unless some method of enrichment is adopted.

Whether, in new plants, the installation of a double hydraulic main and double systems for recovering by-products, will be profitable, depends upon the size of the plant and upon the percentage of surplus gas that can be sold.

Gas is the only by-product in coke manufacture that must be sold locally, and as fast as produced, and unless local gas requirements are large, the operators cannot afford to make any investment or change in operating methods to improve its quality. Not that the gas is not satisfactory for all domestic purposes; it is, and the supplying companies should be allowed to take it and distribute it without enrichment.

Coke oven gas and coal gas are often enriched with benzol to increase illuminating value, but while its use for candle power enrichment is satisfactory, the amount of heat obtained per candle of enrichment (6 to 8 B.T.U.) is so low that to raise the heating value any considerable amount gives a gas too high in heavy hydrocarbon vapors, unstable in quality, unsatisfactory for general use, and, furthermore, very costly.

A description of the present conditions in Europe may be of interest, inasmuch as their present conditions are indicative of what may be expected in this country. In England about 90 per cent. of the gas sold is coal gas, carbureted water gas, as a rule, being used only as a stand by. For some years the illuminating value requirements have been gradually reduced by governing authorities, until coal gas averages not more than 10 candles, flat flame, with a heating value of from 525 to 550 B.T.U.; and this is gas made from coals that are as good as the best gas coals in the United States. This low standard has been adopted after a scientific study of the subject, and upon determining that obtaining the greatest possible amount of heat in the gas from a pound of coal is the most economical method of producing gas. Similar investigations, by German and other Continental authorities, have led them to adopt heating value standards low enough to allow the manufacturer to try various systems for coal gas carbonization, and have resulted in the development of a process of carbonization in bulk, which has made such strides that gas in these countries is being used for many purposes not possible in America.

These are the calorific standards of some foreign cities:

City.	B. T. U. Average.
London	500
"	450
Tottenham	500
"	450
Berlin	543
"	522
Paris	550
Nancy	539
Rennes	570
Chatres	506
Valence	506
Marseilles	551
Milan	573
Buenos Aires	570
Colombo, Ceylon	400

One important point, frequently not considered when drawing up regulations, is that the requirement for testing gas at any place other than the manufacturing plant is unnecessary, and involves a duplication of work. When candle power standards were common, it was necessary to test the gas some distance from the plant, in order to insure the delivery of a uniform product to the consumer. With gas under a calorific standard, however, the loss of heating power in the distribution system is nearly constant for all seasons of the year, and if a uniform quality of gas is sent out from the plant, the consumer may be sure of gas of a uniform quality. Regular tests of the gas quality must be made at the plant to operate efficiently, and tests required at an outside point only mean that this work must be duplicated, entailing additional expense without benefit to consumer.

Whatever differences of opinion may exist in regard to the best method, the common aim of State commissions and gas companies is the supply of serviceable gas to the consumer at the lowest cost. It is the opinion of the writer that a standard lower than 600 B.T.U. will most economically serve the interests of the people of this and all the other States.

[Official Report.—Continued from Page 134.]

FORTY-FOURTH MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

First Day—Morning Session.

Discussing the Paper[1] by Mr. C. A. Learned on "Notes on Vertical Settings in English Works."

The President—Gentlemen, you have listened to a very pleasing account in very pleasing manner of the practice in English gas works. As pioneer of the introduction of some English methods in this country I would call upon Mr. J. S. DeHart for a few remarks.

Mr. De Hart—I don't know that I can say very much more than Mr. Learned has given you, except, perhaps, in reference towards the end of his remarks, where he touches on the firebrick question. I spent a little time when last in England to learn why the Englishmen were getting better results from their material in vertical retorts, and made a short trip to Scotland to see the manufacture of brick in the Glenboig district. I obtained analyses of the brick from several other plants, and also as to some from the southern part of England. Obtaining analyses of our American clays, and comparing the two, I found that the brick which was satisfactory in England ran very high in silica, very much higher than any of our American clays. I also found that the brick used in the vertical settings were burned very much higher than the material we were using, and that they were testing samples from each shipment of bricks as they came to the plants for shrinkage and fusion to be sure that all the shrinkage had been taken out in the kilns. Coming back here I found that the coke oven people were using a quartzite material, or a clay mixed with considerable straight silica rock, which compared in analyses very closely to the English clays. We have used this material in our settings because it shrinks less under working heats than material made from our American clays. Later we were approached by the silica salesmen, and our offices were open, night and day very nearly, receiving the gentlemen who had something to say about silica. We asked them for laboratory tests, as we wanted some figures upon which we could rely. The condition which finally decided us in the adoption of silica, in preference to quartzite, was the higher conductivity which was shown by laboratory tests. When we stopped to consider that the material we were using in the ordinary clay retorts, which contained a large quantity of coarse grog, and when we consulted our experience in refrigerator work with material which we used for insulating, we soon came to the decision that the ordinary clay retort was about the best insulator we could have used between the combustion chamber and the coal. We now feel, as a good many of the horizontal men do, that we must use straight 96 per cent. silica in the combustion chamber and retorts of our settings. We can take care of the expansion problems in our settings very well by allowing the silica to expand vertically, with plenty of room in the top iron work to take care of it, and provide for the horizontal expansion with large joints filled with pitch. All horizontal expansion must be absorbed by internal joints, as the tie-rods and buckstays will not prevent the material from expanding regardless of their size and strength.

The President—Mr. Nettleton, would you care to add anything to what Mr. Learned and Mr. De Hart have said?

Mr. Nettleton—I am not prepared to say very much at this time on vertical retorts. First, I want to congratulate Mr. Learned on the paper he has presented. He has brought to us a lot of valuable information as to what is being done in England with verticals, and the opinions of many men as to their merits, and he has presented these in a most interesting way. A year ago I presented a paper here, which gave the results of the vertical retorts at Derby, at that time, and these were obtained largely from tests made by Dr. Beardsley, the chemist of the New Haven Gas Company, and his assistants. They looked very favorable indeed, at least they seemed so to me. The results at the present time are not nearly so good. The cause of this falling-off is almost entirely due, in my opinion, to the quality of the fireclay material which was used in the retorts and settings. It has shrunk, and shrunk badly. Some of the retorts have also gotten out of line. The coal bridges in the retorts and makes a large amount of very unpleasant work on the top of the bench. On the other hand, it is only fair to say that we are doing with these settings, even under present conditions, very much better work than we did with the horizontal settings. It seems to me it is only a question of time when a vertical retort and setting will be developed which will last as long as the English verticals and will do equally good work. We are doubling our plant at Derby, and that shows better than anything else the faith of the management of the Derby Gas Company in the vertical retorts. In the new plant, silica retorts made of blocks (that is, sectional retorts) are being used and they are very much larger than those we now have. We hope for a very much larger yield per retort, a better candle power than we now obtain, and also a much larger yield per man. I have not seen anything yet that causes me to change my opinion, that, for small works at least, the vertical retorts are the best things yet brought out; but, so far as the experience in Derby goes, they have not yet been perfected.

The President—Will Mr. Stiles, of Fitchburg, give us some of the results?

Mr. Stiles—In the last part of his paper Mr. Learned speaks about material. I think that the success of the verticals is going to depend on the success of the manufacturers in getting materials to stand the heats that you can get on verticals. We have found in our experience that you can get about any heat that you want, but we still have to find the material that will stand this heat. While we get samples of silica and firebrick that are given the fusing point probably of 3,400° to 3,200°, when in actual operation with temperature, I think in the bench that the fusing point will probably be 300° or 400° lower. In our first installation the combustion chambers were lined with silica of an English make, and as near as we can find out there was only about 85 per cent. silica in it; therefore, when we tried to carbonize the American coal we did not get very good results and had to drop the temperature. I have a few figures here, on a year's operation of the first bench we installed: Average daily make of gas, 203,000; make per mouthpiece, 25,462; number of men employed, 2; make per man, 101,852; make per pound of coal, 5.32; coke used per 100 pounds of coal, 16; candle power, 15½; candle feet, 82.5; gallons of tar, per gross ton, 14.6; ammonia, 5. We installed a second bench of verticals, and while the construction is a little different, it is constructed entirely of American material. When the first bench was installed the English concern sent their representative over here to do the work. Of course, we thought he knew all that should be known about construction work, but we have found out, since building our second bench, that if we had watched him as closely as we watched the men who built the second one we would probably have had better results on our retorts, because we found that the smoothness of the retorts has much to do with the operation and prevents hanging up. On our second bench, after the retorts were installed we rubbed them down very smooth. I might say it has been working now about 3 months, and we have not had to open the bottom of the mouthpiece for any hanging-up of any charge (and it has been working continuously), whereas in the operation with the first bench we had to keep men poking once in a while to get the worm to take hold. Another thing that we have noticed is as to the iron work on top. Even the rivets that make up the storage hopper should be all flush, and the ironwork should all be smoothed down, for if you take coal that is a little bit damp any roughness there will cause the coal to hang up. While the construction of the bench does not make it very unpleasant to poke down the coal, the valve on the top of the take-off pipe is nothing but a shot with a hole through it, and a man, using a bar pretty near the size of that hole, of course, does not get much gas out, and it only takes a little time to loosen that up. As I said, regarding material, I think it is up to the manufacturers to get a material that will stand the heat, for there are a lot of places in the construction in which you are going to have material where there is practically no absorption, I think, even as the firebrick, they have to find a mortar that will stand up as well as the brick. I believe if you don't find that you will note that, in their construction, the bricks have probably shrunk a little in manufacture, enough to make a distance in the joint, and the minute you get large joints in a vertical bench, and you have not the mortar in there to stand the same temperature as the brick, you are going to get the shrinkage and something is going to drop down. I have a few figures here from the second bench, which, as I say, has only been running a short time, but a little better than the first bench: Average daily make, 237,000; make per mouthpiece, 29,660; number of men, 2; make per man, 118,642; make per pound, 5.49; coke used per 100 pounds of coal, 13.9; candle power, 15.3; candle feet, 83.9; tar, 15; ammonia, 5.

The President—Would Mr. Burgi care to add to what has been said?

Mr. Burgi—I have to side in with Mr. Stiles; it seems all a question of getting a material that will stand heat. The reason why we

1. For the text of the paper, see Journal, *ante*, p. 134.

do need more heat than they do in England is all in our coal. Three years ago I took 200 tons of coal from here to England and tried to put it through a setting in St. Helens. That setting was running all right It was passing the English coal that they were using (half slack and half nut coal) all right. They had a good heat in the combustion chamber, and the coke came out well burned. The very minute our coal went into those retorts down went the heat, and they were not able to burn the coke properly; in fact they were not able to carry enough heat in the setting to burn off the coal. That is the reason why we have so much trouble over here. I don't know whether we will be able to get a material that can stand that heat; I have not found it yet. People say there is material made that will stand 3,500° or more, but I have tested a number of samples, and had them tested by a concern that makes a business of testing materials, but about 3,200° was the best I could find. Silicate material, as Mr. De Hart said, has a better conductivity of heat, and it is possible that we need not apply so much heat on the outside of the retort to carbonize our coal; but, after all, when you let gas and air go together, such as we use in our benches, the temperature will sometimes run up to more than 3,000°, and the material then will not stand up. For instance, if there is no absorption in the retort the heat in the setting will run right up. We notice that in Fitchburg right along. If there is much stoppage, such as we had in the old bench there, then the heat will go right up, and the material will not stand.

Mr. De Hart—I want to make one further remark. I don't want these gentlemen led to feel that higher heats must be carried in a vertical retort than in a horizontal one, or that you need any better material, necessarily, in a vertical retort than in a horizontal retort; but you must provide for the shrinkage which takes place in a vertical retort which in a horizontal retort you seldom notice. You must take care of the shrinkage which will take place at the normal working temperature, if you are using clay material, regardless of conductivity or anything else. We have come to the point where, if we use a clay retort which we know will shrink, we must make a loose collar through which the retort can go down, independently of everything else. The tile and brick which we used in the settings are entirely different from the materials in the retort; the former is a very close material and has very little shrinkage in it. If the retort is not independent, so that it can go down, the joints will open up. You can do this gradually, running along slowly, taking the shrinkage out of your material, and simply after each scurfing patch your retorts around the joints and go right on again; but you must take into consideration that shrinkage and provide for it. In a horizontal setting the gas is coming up through the center, hence you get a greater shrinkage in the horizontal retorts on the inner side. The retort tends to give a little, but it is a very slight amount in a horizontal setting. The same amount in a vertical setting, with the top section of the retort hung up in the cover of the bench, the lower section becoming shorter, you will soon have a space in the retort where you can place a brick. If the retorts are plumb you can insert bricks and continue working.

Mr. Burgi—A shrinkage of retorts has not been our experience. The first setting has been running over two years, and the retorts have not shrunk a bit; but the fireclays, with the silica material on either side, have shrunk. The silica material which was in the first setting absolutely ran away. In this second setting we carry pretty high heat. We find that the center walls, which are coated with these tiles, have shrunk to a certain extent.

The President—Have any members any questions to ask these gentlemen in regard to English practices?

Mr. Taussig—I have been making a study of firebrick material for vertical retorts, as we have had similar troubles to those of Mr. De Hart and Mr. Stiles. It is not that we have not refractory enough materials in America. We have plenty of them, of just as fine material as can be found anywhere. The trouble is that we have not as yet learned how to make a consistent material, a material about which we know how it is going to behave every time it is made, and be able to duplicate the same material. I want to call attention particularly to some experiments that have been made in Washington, which should be brought home to every firebrick manufacturer and be studied by every man contemplating firebrick work. They now make tests that enable one to tell just how much a brick will stand or how much it will shrink under load conditions. The refractoriness of a material does not necessarily mean how well it will stand up under working conditions. We have used some of the most refractory materials made in this country, that stood 3,300° or more, that would not stand a load when it got beyond say 2,500°, without shrinking excessively. When a brick reaches a certain temperature it changes its structure, and although it will not melt there is a sort of internal change in composition which makes it solidify and come together without any noticeable change in the general structure of the brick other than its becoming more dense. We have brick that we have taken out of a furnace that had not been heated above 2,550° that shrunk excessively, and still appeared to be in a perfect condition, not a sign of vitrification having taken place. We have also been making tests, copying the general tests made at the Bureau of Standards, in which we are heating brick to the working temperature we expect to use, and loading this brick to the working load. We obtained some very interesting results in this direction, and found that the brick will stand the load under, say, 2,500° heat without any appreciable shrinkage. When heated up to 2,600°, a margin of 100°, it will shrink ¼-inch in 9 inches. I want to emphasize that this is an important point when we build brickwork for high temperatures. The trouble with us in verticals is that we are trying to get the maximum capacity out of our settings. We have rated our settings too high probably for the material which we have to carbonize. I think if we will be a little more conservative, or be content to run under moderate temperatures, and get little less capacity per retort, that we will get firebrick in this country which will hold up. It means simply a reduction in heats. In conclusion, I would like to say that verticals can be run with a good grade of domestic material, if we can obtain from the domestic manufacturers a uniform product that will not shrink under working conditions of temperature and pressure.

Mr. Miller—As Mr. De Hart says, it is not necessary, although most everybody seems to think so, to run higher temperatures with verticals than with any other type of bench. There is no reason whatever, in my experience, why the temperature should exceed 2,300° or 2,400°. And I must differ with these gentlemen. You can get materials in this country, both silica and fireclay, that will stand these temperatures. If you do want to get a great capacity out of your benches, you can run a higher temperature, but I think, even with the silica material, that the wear-and-tear with these high heats, and the greater care you have to take in operating the benches, will cost you more than running a lower temperature and getting a lower capacity. I think several of the gentlemen who spoke have been pretty hard on our refractory material manufacturers. You can get good materials in this country; and I wish to lay stress on that point. There have been a great many failures here due to overheating and using material that shrinks, when a expanded material should have been selected.

Mr. Ramsburg—Before you leave the subject I would like to call attention to one very important difference between clay and silica materials. Clay does not expand nearly as much as silica at low temperatures, but above 2,000° F. the action is very different. A firs quality claybrick begins to shrink at this temperature under load, and at 2,400° F. this action becomes very marked. With true silica brick the curve of volume is practically a constant from 2,000° to 2,600°, above which temperature there is again a slight expansion. It seems to me this variation is an important point in the successful operation of continuous vertical systems. Another point which seems worthy of attention is the influence of the "built-in" producer. As long as one runs the producer in conjunction with the retort settings, with the great variation in the composition of the producer gas, and the influence of the fluxing action of the accompanying flue dust, we are going to have difficulties from too intense a combustion. The solving of the problem to me lies in the operation of an outside, forced-draft producer, so run as to give a continuous supply of low calorific constant quality gas, from which the dust has been removed. If you are operating electrical apparatus, you are very zealous to see that such apparatus is safeguarded by automatic circuit breakers and fuses. In controlling the heats from an outside source, in a manner to prevent this unexpected increase in flame temperature and consequent localized overheating, you are adding a safeguard absolutely necessary for continuous operation.

The President—I feel as though Mr. Daniel R. Russell could enlighten us somewhat on this firebrick question.

Mr. Russell—This question of refractoriness is a very difficult one In the first place, American manufacturers, as Mr. Taussig says, have at hand, in my opinion, raw material equal to any other in the world. Of course, in making their mixtures they may have to secure from one locality a certain kind of material and from another locality another kind of material, so as to get the mixture that they want. It is very well known that a material which will run high in alum-

ina will stand a higher heat than one containing silica, say 65 per cent. On the other hand, material with a high amount of alumina will shrink very much more, and not only shrink but, as Mr. Taussig says, compress. When the heat gets high, if there is no weight on the material it shrinks, but when you put a weight on it it will also compress; so we must make a distinction between the compression and shrinkage. I think the American manufacturer is capable of making materials which will run very uniformly, of course within certain limits. We cannot have it exact every time, but sufficiently close to produce an article that will be entirely satisfactory, provided he knows the conditions under which the materials will be operated and if the operator will stick to that coal. The trouble is they don't. For instance, they get their bench operating, and the next thing that happens is they get a different coal, a coal that requires a little more heat. They alter the drafts, and the next thing that occurs, as Mr. Burgi said, they have a great deal more heat than they have any idea of; but they never know it. They don't take records right along, and the damage may be done in a very few hours. A difference of even 100° on certain materials will make all the difference in the world. I think myself that the attempt, as Mr. Miller says, to get a little more capacity out of a given amount of money spent in a plant, or a little more yield from the coal that is furnished, has caused a good deal of the trouble experienced. Speaking again of Mr. Burgi's remark, if you make a quartzite material (that is, what we call quartzite over here) which is made for coke ovens, you can produce a material under certain conditions that won't expand or contract, or at least will do so to only a small extent. But it will not stand the heat—that is, high temperatures—as well as either silica or a fireclay silicious material, and if you try to put the heat on you are then going to have trouble, because it will fuse. Provision should be made, as Mr. De Hart says, for expansion, if pure silica material is used, or contraction or shrinkage if fireclay material be used, and then, I think, if you keep within reasonable bounds, you will have no trouble with either foreign or domestic materials. One great trouble is the operator does not keep track of the heat, as he claims he does. It is left to a man who is supposed to be responsible, but who is not responsible, or at least who does not take care to see that the heat is within the required limits. The trouble takes place, and then the whole thing is dumped right over on the firebrick manufacturer, and the latter has been carrying that pack for years and years. I know of one company which at one time made up materials to suit an engineer's designs. The company did not have anything to do with the designs. It did not have anything to do with the construction. It did not furnish a mason or anything else except the material. I looked at the benches—I am used to looking at heats in benches—and I stated to the engineer in charge, "These heats are simply fearful." There was almost an electric blue in the combustion chamber. The materials went down, and rather than have any discussion about it, although there was no responsibility, they replaced the work, and it cost about $25,000. He learned something at the unfortunate's expense. Such is the history that every firebrick manufacturer has had, not only in gas works practice but in steel works and glass works, all the way down the line, where they use refractories.

Mr. Polk—I would like to ask anybody operating these vertical benches what the highest temperature he can state positively is maintained in them—not what he thinks it is, but what he positively knows it to be.

Mr. Taussig—We make it a practice to determine our heat regularly with a Wanner pyrometer, and we can vouch that our temperatures in the combustion chamber never exceed 2,600°. We try to run them below 2,500°, but never above 2,600° in the combustion chamber. That is about 100° more than the retort chamber temperature. Our combustion chambers are so designed that there is no load on them, and shrinkage is immaterial; so if we have a material that will stand over 3,000° in our combustion chamber we have no trouble below this temperature; but, as Mr. Russell has said, and as I will again emphasize, material under a load is a very different from one that is just being tested in an electric furnace. Material will change under load where it would not change at all if not loaded, and that is an important feature.

The President—Mr. Miller, would you care to tell about the practice in Providence in regard to temperature and its control?

Mr. Miller—We have a man whose sole business it is to look after the retort house; you might call him the retort house superintendent. He regulates all the heats and takes the temperatures in every bench every day. As I said a while ago, we seldom run the temperatures over 2,400°; our standard is between 2,300° and 2,400. We have both domestic and foreign materials, and, as far as I have been able to see, with the limited time the domestic has been in use, one of them is as good as the other. As Mr. Ramsburg mentioned, where dust collects in the setting it will cause the material to flux or melt at a much lower temperature than if it were clean, it may be several hundred degrees.

Mr. Kennedy—Are Mr. Miller's records of temperature taken in the daytime or in the night, or both?

Mr. Miller—They are usually taken in the day; but we have taken them at all times of the day and night.

Mr. Kennedy—In other words, I am trying to find out whether it is worth the money that you spend in taking them only one part of the day, that is, of the 24 hours, when in 6 hours at night you can do all the damage that is required and be straightened out pretty well, as far as temperature is concerned, by morning.

Mr. Burgi—May I ask Mr. Miller how much heat they carry in their settings?

Mr. Miller—I said between 2,300° and 2,400°; that is, at the hottest point. While speaking on this subject I might mention that it is possible to, for instance, have a temperature of 3,000° say at one point, while nowhere else would it be over 2,300° or 2,400°. There are a great many faulty bench designs where the flame may impinge directly on some part of the setting or retort, where you get a high local temperature, and that is a point that must be considered and guarded against. I think probably that there have been a great many settings ruined due only to local high temperatures.

Mr. Taussig—I don't want to say too much; but, in connection with the discussion of temperatures, I think it is very important to all gas works to make sure that their regulations are constant throughout the day and night. We know that where we have individual producers, one of the handicaps, as Mr. Ramsburg has said, in that the fire conditions will vary. One time you will get just the right amount of air combustion, and at the other time you might not get enough, etc. We have made a special effort of late to keep our producer conditions constant. In connection with Mr. Gartley's department we have been developing a scheme by which we actually blow our primary and secondary air, our primary air being mixed with the products of combustion. We measure both primary and secondary products and keep them constant at all times of the day. We know that we cannot get beyond a certain temperature with a certain proportion of return products used as primary air under the grate, as we have only one point of mixing these products. We think we will overcome any irregularities in the quality of producer gas and thus get the best conditions for long life of settings. I think we should all work to get good heat regulation. This would protect the firebrick manufacturer and fulfill our part of the contract for the firebrick which he is manufacturing.

Mr. Stiles—At Fitchburg we have been very particular in watching the temperatures, and, as Mr. Miller said, we may have 3,000° at one point and only 2,200° at another. We put in cones, beside taking readings with a pyrometer, and at the point where our combustion takes place the temperature probably will run around 2,500°, but not over probably 8 feet from there we would not have to exceed 2,300°. We have a sort of general man around the works who takes candle power, makes our B. T. U. tests, etc., and watches this bench, beside the operator. It is part of his duty to go around ever so often. The bench is constructed so that you can see about every part of it, except the inside of the retort. You can see where the gas and air come together. In our operation we have damper regulations, by which we can regulate the gas and air so that they will be constant. I think that, as far as the temperature is concerned, is a pretty important factor. When I spoke about the material standing the temperatures I did not mean that we were trying to see how high temperatures we could get at Fitchburg. We are running them as close to 2,600° as we can, and that is on the side of the bench where the combustion practically takes place. The results that I read are with the temperatures practically as close to 2,600° as we can hold them, and this temperature as close to the point of combustion as possible.

Mr. Miller—Mr. Taussig mentioned keeping the conditions uniform, which I think is one of the most important points. Probably more mistakes have been made in designing and operating the producer than in any other part of the bench. You might go throughout this country and I doubt very much if you would see a-half dozen properly designed producers. With a properly designed producer, and with a shaking grate, measuring the air and steam, and exhausting the products of combustion away from the bench, you can keep your conditions absolutely constant throughout the 24 hours.

The President—We have strayed somewhat into the firebrick business. I should like to take you on an imaginary trip across the English channel and drop you over into Germany. Mr. Ellis, will you tell us something of German methods in this country?

Mr. Ellis—I am interested in this discussion, and surely wish to compliment Mr. Learned on his paper. It is such a very good compilation of a man's trip in England on this question of vertical settings, and it surely will be very useful to anyone visiting England to know just where to pick out the best places to visit. As President and Manager of the Providence Gas Company, possibly I may repeat I am very glad to say that the Providence Gas Company is the pioneer in vertical gas retorts in America, and possibly I may be somewhat reminiscent on that account, as we have the oldest as well as the largest installation of vertical retorts. The Providence Gas Company, at the time it decided to put in the verticals, was in such a condition that it was obliged to act. The coal gas plant was really gone by; it was, as you might say, in the worst state of obsolescence that could be imagined. After visiting Germany (also England) it was thought best to adopt the Dessau vertical system. In fact, as manager, I decided it was best to do something rather than do nothing. At that time the Glover-West, I think, was not in vogue at all; I don't think they had established their patents. The first two stacks of our verticals were built in 1910, and put in operation about October of that year. We have filled the house and put in a third stack. Recently (October last) we installed the fourth stack, so that we have a house of 270 retorts to-day. The last stack, of course, is an improvement on the others, and I would say it has given excellent results as both the top and bottom mouthpieces are tight in every respect, and the working conditions have been excellent up to this date. That stack is 6 benches of 15 retorts, each in rows of threes, and 5 benches of the Stettin material. One bench is the American material. We decided to build in this manner and let both materials test out one with the other; and note the result. Three years from now we might know the difference. I think at this time we can hardly say any has yet shown in these settings. The mechanism also of this fourth stack is imported; in fact, it is an imported stack throughout. For one reason I decided perhaps it was much better not to mix American and German, either in mechanism or anything else, for I found with two contractors that, when I went to the works and they were not working right (I was sometimes called a "Jonah" because everything was working wrong when I visited there), it was one part of the material was wrong, the other was right. So that this fourth stack, which is entirely an imported installation, is giving excellent satisfaction, as I think will be borne out by your President here, our Superintendent, and Mr. Miller, our Engineer. As to the test on this fourth stack, as far as the yield is concerned, it is impossible to make a statement, for the whole 4 stacks are connected together; but I would say in regard to the coal that we have a 10 per cent. increase of coal in charging the retorts, of the amount that was established in the contract. We also have a fuel test of about 15 per cent. better than guaranteed. Labor, however, was increased. They had the right to make two tests, one of which has been made, and the contractors have not asked for any second test. I really think, if a second test was made, it would be much better than the first test. About one other matter I would like to say a word, and this discussion has brought the thought to me. I think there should be greater co operation between the company and the contractor in building vertical retorts. They are something new in this country. We have climatic conditions, fuel conditions and material conditions. You can make a contract (in my experience, not only as an executive of the gas company, but in other corporations) as rigid as you please, but there must be a hearty co-operation between the contractor and the company in order to get the best results. I think we shall all be very much pleased to see the result of the Woodall-Duckham, the Glover-West and the U. G. I. vertical retort systems. For my part I wish them the most success possible, the most abundant success with their works. The Providence Gas Company's works have always been open to inspection and criticism from the gas men, and they are so to-day. I hope any member here who wants to visit the Providence Gas Company's plant will do so. He will find your President there all the time, and our Engineer willing to give you any information possible, whether we have made mistakes or not, so that you may get the benefit of them. I thank you, gentlemen.

The President—Mr. Miller, would you care to give them some figures on the results of operation?

Mr. Miller—Well, Mr. Ellis told, in a general way, what the results are. As he said, for the fourth stack we can only give the labor, coal and fuel, because the gas, tar and ammonia are measured together with the other three batteries. These figures are for the official test, of one week, ended November 15th last. The average weight of coal per charge was 1,005 pounds; 920 pounds guaranteed; time of charge, 10 hours. The generator fuel was 14.95 pounds of coke gross, 16 per cent. guaranteed. After taking the coke out of the ashes we had a net figure of 13.45 pounds. Mr. Gifford wrote asking if I would give our results of operation for 1913. They are as follows: We made 5.02 cubic feet per pound of coal; candle power, 11½ on a flat flame burner—that is probably equivalent to between 14 and 15 on a Sugg-D, possibly 16 to 17 on a Metropolitan No. 2; B.T.U., 589 per cubic foot; gallons of tar per gross ton of coal, 14.6; ammonia, 6½ pounds per gross ton.

Mr. Taussig—May I ask if that is per gross ton for your residuals?

Mr. Miller—Per gross ton.

Mr. Sayer—I would like to give the members present the benefit of some experience that our Company has had with silica material. For some years we have been building benches, using fireclay retorts and fireclay settings, and our experience with this class of fireclay material has not been satisfactory. The retorts would last all the way from one year to three; some times, using great care, they would last four years. About five years ago we started making some practical tests and experiments with silica material, and the result of our experience has been as follows: Up to the present time we have installed several hundred benches, using sectional silica retorts and settings, and have not had a single complaint or failure with this material to the present time—I am speaking now of horizontal benches entirely. We have had benches of silica material running for 4½ years, one of which was recently torn down for the purpose of making room for other apparatus, and we found that the silica settings were almost in as good condition as the day they were installed. The bottom part or floors of the retorts near the mouthpieces had partially worn away to a distance of about 2 feet back, and this portion of the retort required replacement. I understand that Mr. Barnum's experience at Worcester has been somewhat similar. I think the silica retorts and settings at this plant have been in operation approximately 4 years. I understand that recently they let down the heats on the benches and renewed the floors only of these retorts, and that the sides and tops of the retorts had not been disturbed, for this portion of the retorts was in a very satisfactory condition and did not need replacement. I think it might be advisable to ask Mr. Barnum exactly what his experience has been. Apparently they will get 3 or 4 years more life out of their silica retorts and settings. In the coke oven industry for many years they used fireclay material for lining their ovens and, from inquiry, I find their experience with fireclay has been quite similar to what the bench people have had with gas benches, the linings of the ovens would last from 2 to 3 years. The Semet-Solvay Company at the present time have some ovens lined with silica that have been running 7½ years, and they expect to get several years more, giving a total life of approximately 10 years, so I can see no reason why we are not warranted in anticipating a similar experience with silica in the matter of gas benches. In some of our half-depth bench installations we have benches operating alongside of each other, some benches being filled with fireclay retorts and settings, the others with silica retorts and settings—the benches themselves are identical in respect to design and size. In the benches filled with fireclay retorts and settings we are able to carbonize only about 6 tons of coal per 24 hours, while in the benches adjacent to them, using silica retorts and settings, we have been able to carbonize a little over 7 tons of coal per 24 hours. The retorts in both instances are 16 by 28 inches, and 9 feet in length. On looking into the retort oven of the benches containing the fireclay retorts, the temperature in the combustion chamber, the settings themselves, and also the outside of the retorts, was considerably higher (that is, as far as appearance is concerned) than in the benches containing the silica retorts and settings, notwithstanding the fact that the silica benches were carbonizing over 1 ton of coal more per 24 hours; and, in the speakers' opinion, this is more or less of a practical proof that silica must be a better conductor or transmitter of heat than fireclay. As far as we are able to judge, silica retorts and settings in horizontal benches should last not less than 6 years, where, under the same conditions, the fireclay will last not over 3 years. At the end of the fourth year it may be necessary to replace or renew some or all of the silica sections in the floor of the retorts. Generally speaking, from our experience, there is very little comparison between fireclay or silica as a material out of which to construct retorts, and it is our

(*Continued on page* 218.)

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BRIEFLY TOLD.

"All Aboard for Mobile!"—Such is the heading to this brisk circular, from H. O. Hanson, Assistant Manager, the Mobile (Ala.) Gas Company, respecting the near-to-hand convention of the Southern Gas Association: The Southern Gas Association will hold its fifth annual convention in Mobile, Ala, April 22d, 23d and 24th, which city will prove very interesting to visiting gas men and their friends, as it is one of the most noted cities in the country. Mobile, which celebrated its bi Centennial Anniversary several years ago, has the unique distinction of having served under 5 flags, and still gives evidence of these different influences. It is a thrifty, growing city of about 65,000 inhabitants, is located at the head of Mobile Bay, on the mouth of the river of the same name, which drains the second largest system of rivers in the United States. It is a very popular city for conventions, being possessed of several large modern hotels and restaurants, several of them being world famous for their oysters and sea food. Mobile gas works (one of the first half-dozen plants built in the United States), was built on a tract of over 7 acres, and this to-day is the location of its modern plant. Built in 1834, by Mr. Wm. H. Caldwell, who also built the first gas plants in New Orleans and Cincinnati, in 1833 and 1836 respectively, this local Company was operated and owned by the heirs of the original builder, until 1906, when it was purchased by the Dawes Brothers. While the site of the present gas works is exactly on the same tract that was bought for the original works, it is needless to say that none of the original apparatus or buildings exist. In fact, under the new ownership, the entire plant has been rebuilt along the most modern lines. It is a combination coal and water gas plant, using high grade Alabama gas coals in inclined retorts. Water gas is made as an auxiliary, when the sudden increase in demand, due to the large heating business, exceeds the regular coal capacity. To give an idea of the necessity of this auxiliary service, it might be stated that the average daily output this past season was approximately 800,000, and on several occasions, during cold snaps, this output would jump to over 1½ millions. The coal gas plant consists of 8 benches of inclined 6's, of full silica, sectional retorts and settings, as built by the Gas Machinery Company.

The retorts are 15 feet long, 24 by 15 at the charging end, and 26 by 15 at the discharging end. These benches are operated by 4 men on a shift, who handle everything but the coal to the bunkers. The coke quenching hoppers are of the McDonald-Mann, water-sealed type, which give an unusually bright, dry coke. The interesting feature of the arrangement for removing coke from the retort house is the single track, endless cable railway, which operates out onto an elevated trestle. The car, of the automatic dump type, is driven by a reversible variable-speed motor, which is controlled from the retort house. As to the particular features regarding the sale of the coke, it was found very necessary to prepare it in several sizes, in order to dispose of it profitably; and, for this reason, the Company is now building a complete conveying and screening system, with bins of large capacity for loading either wagons or railroad cars. This feature of the plant will be of especial interest to the gas men, as the profitable disposal of coke is an ever-pressing question, and will become more so now, on account of the very general return to the coal gas practice. The arrangements made in this respect, and which it is hoped to have completed and operating at the time of the convention, consist of a 40-ton initial bin, filled by automatic dump cable cable car from the retort house. The coke passes through a reciprocating plate feeder unto an inclined belt, on which it is carried to the top of the 500-ton storage bin, and there discharged onto shaking screens, the size of these screens being arranged to remove the pea and breeze, and placing the nut coke, stove coke, and screened lump in separate pockets. This same conveying belt is extended beyond the feeding bin into a pit which will permit the reclamation of the excess storage that is piled on the ground from the trestle during the summer season. This conveying and screening system, known as the "Parrish Shaker Screen," is being installed by "The Link-Belt Company." The other buildings, including new storeroom, fitting shop and concrete purifiers, are also worthy inspection. Another historical point about the Mobile Gas Company, is that at one time the famous gas engineer, H. H. Edgerton, was in charge of its operations, and it was at this old plant that he invented and made famous, the photometer standard, known as the "Mobile Standard" or "Edgerton Standard."

For visitors who are particularly interested in the accounting end of the business, they will find much interest in the system of "No Consumers' Ledger" used here, where the bills are records made and abstracted directly from the meter reader's route slips. This feature of accounting has been in use in Mobile several years, and has proven very satisfactory. It saves considerable office labor, and also gives a very valuable analysis of the sales referring to the abstracts covering the various different routes. As to its commercial developments, the Company is quite proud of the gas cooking school, inaugurated here over 5 years ago, to give practical instruction, by course of lessons, to the negro cooks. This feature has been a salvation in securing general cooking with gas in the homes where formerly it was thought too expensive to allow the cook to use it. As to commercial gas lighting, Mobile can boast of as large a ratio of this business as any other city in the country. There are numerous large installations of outside arcs. Indeed the Company has much more of this business than its friendly rival, the Mobile Electric Company. The Mobile Gas Company expects this convention to be a record breaker in attendance, and will welcome gas men and their friends from all over the country. Last, but not least, novel entertainments are being planned. Probably a boat ride on the famous Mobile Bay will figure therein. There will be a banquet, at which the guests will be fed and fittingly entertained. A very pleasing programme is being arranged for the lady guests of the convention, and all the delegates are urged to bring their wives. Hotel reservation may be secured by addressing Mr. R. B. Wright, care of the Mobile Gas Company.

Ready to Start National Advertising.—Mr. Louis Stotz, Secretary, N. C. G. A., informs us that the National Advertising Committee, the Trustees of the National Advertising Fund and the Board of Directors of the National Commercial Gas Association have decided unanimously that a sufficient amount has been pledged to begin the campaign. Subscriptions are, therefore, being called in, and as soon as collected, the plan will be put into active operation. The concensus of opinion is that with the total now pledged a comprehensive and valuable campaign can be begun. The George W. Edwards & Co., advertising agency, Philadelphia, selected by the Association to look after the campaign, has been working for some time studying the plan to be mapped out, and will be ready, as soon as funds have been collected, to start advertising in national magazines. The fund raised to date is sufficient, in the opinion of those who are back of this great movement, to begin a comprehensive campaign, and all companies which have not yet subscribed are being solicited. Further it is hoped that at an early date the total amount will be greatly increased. It has been found in the work of the British Commercial Association that many of the undertakings which subscribed last year, have greatly increased their subscriptions for 1914; and it is anticipated that the showing which the National Commercial Gas Association will be able to make in the next few months, will be such as to warrant a great many more companies coming into the campaign.

To Develop Mineral Resources.—Measures favored by the present administration to foster development of the coal, oil, phosphate and potash deposits of the Western States have been introduced in Congress. In general, the bills provide for leasing the public lands under safeguards against monopolization and partial development. Single permits for the exploration of 2,560 acres of oil lands will be

issued, giving exclusive rights for 2 years, during which the work done must aggregate 2,000 feet depth. If oil is discovered, the permittee may receive a fourth of this area in fee, the rest remaining with the government—subject to royalty leases in small tracts. Waste of oil and admission of water to oil strata are punishable by forfeiture. Coal lands are to be sold, as at present, in small blocks but with provision for leasing—any holding not to exceed 2,560 acres. To supply local needs, 10-year permits may be issued for up to 10-acre tracts, no person or association to have interest in more than one lease. General regulations for leasing are to be made by the Secretary of the Interior, with royalties based on production, and a small rental imposed to prevent speculative holding. Royalties from all mineral developments are to go into the Reclamation Fund to be used for irrigation projects. After being so used once, 50 per cent. of the royalties, upon their return to the Treasury, is to go to the State for schools and development purposes.

INDUSTRIAL GAS CALORIMETRY.—The Bureau of Standards has just sent to press a paper on "Industrial Gas Calorimetry," embodying the results of an extended experimental investigation of some 8 different types of flow calorimeters and of 1 calorimeter of the comparison type. The paper will be issued as a technologic paper of the Bureau, and will be available, on written request, in about 10 weeks. The sources of error to which these instruments are liable, the important precautions that should be observed in their use, and the accuracy attainable with them, are considered with painstaking care, and the careful reading of this paper is, therefore, recommended to all interested in testing the heating values of gases.

JOINT MEETING, NEW ENGLAND SECTION, NATIONAL COMMERCIAL GAS ASSOCIATION, WITH ILLUMINATING ENGINEERING SOCIETY.—A joint meeting of the New England Sections, N. C. G. A., and Illuminating Engineering Society, was held at Wesleyan Hall, Boston, Friday, March 27th, and notwithstanding the stormy night, 135 men attended. The meeting opened at 8:30, with Mr. R. C. Ware, of the Boston Consolidated Gas Company, a director of both organizations, presiding. After a short address of welcome, he introduced Mr. C. W. Jordan, of the Photometrical Laboratory of the United Gas Improvement Company, who gave a very interesting and instructive talk on "Recent Advances in Gas Lighting," illustrated by stereopticon views of past and present methods of by-pass and distant lighting, showing the rapid advancement. He made special mention of the artistic gas fixtures now made, affording the gas man a better opportunity to compete with his electric competitors. Mr. Jordan's talk lasted about an hour and a half, and during all that time he held the attention of the members. Mr. Henry E. Warren, Consulting Engineer of the Lombard Governor Company, Ashland, Mass., explained the construction of the Warren Magnetic Valve, which is so extensively used for indoor and outdoor distant gas lighting. The discussion that followed developed some interesting facts regarding the value of distant control lighting to gas companies. At the close of the discussion a rising vote of thanks was given to Mr. Jordan and Mr. Warren for their talks, so ably and intelligently delivered.

FIRE BRICK IN RETORTS.—The discussion started by Mr. C. A. Learned's "Notes on Vertical Settings in English Works," at the New England meeting, brought out a lot of good points. One of these, by Mr. De Hart, was the very poor conductivity of ordinary material, and the advantages of silica material in this respect. From the point of view of the operators who spoke, there was general agreement that vertical retort success was dependent altogether upon the ability of the brick makers to furnish material that could be counted upon to stand the high heats and be thoroughly uniform in quality; and most of the trying experiences were due to shrinkage of brick, and failure under load and heat. Mr. D. R. Russell nicely made the point it was necessary to distinguish between shrinkage and compression, the latter being a failure of the brick under superimposed weight when heated too high. Most of the troubles he pointedly attributed to lack of proper control of heats around the retorts, and in many cases to want of knowledge of the heats really carried. The prevailing tendency was to raise heats to increase yield, and this with lack of care to prevent localized overheating leads to abuse of the settings. Heats are not kept within the limits set because not properly watched and regulated. In closing the discussion Mr. Learned quoted Mr. Glover as saying about the 200 tons of American coal taken to England for test: "Yes, Mr. Learned, we had some difficulty in carbonizing that coal. It took a great deal of heat." So it is evident that American makers of fire brick have a harder proposition to handle; but they can be trusted to solve the problem, as all the necessary materials are at their disposal.

SUBMARINE COAL FIELDS OF CAPE BRETON.—The coal deposits on the northern coast of the Island of Cape Breton, Nova Scotia, were interestingly described by C. M. Odell, at a meeting of the Mining Section of the Canadian Society of Civil Engineers. These coal fields, destined to be one of the largest coal-producing centers in North America, are divided into four basins, known locally as the Morien, Glace Bay, Lingan and Sydney Mines. At present the Dominion Coal Company controls by lease from the Nova Scotia Government, most of the coal areas on the southern side of Sydney harbor, paying a royalty of 12½ cents per ton on all coal marketed, and this forms the greater part of the revenue of the Province of Nova Scotia. The coal is shipped mainly to Sydney and Lewisburg harbors, where modern shipping piers have been erected. In the near future 8 collieries will be added to the Lingan basin, 4 being now practically complete, and producing their estimated capacity of 1,200 tons per day. These new collieries will complete the operations on the Victoria and Lingan basins, leaving future enlargement of production to two other seams.

CURRENT MENTION.—

MR. FOUNTAIN T. PAGE, President of the Gas Light Company, of Waverly, N. Y., and President of the Athens and Sayre (Pa.) Gas Company—the two concerns are jointly operated—died, at his home in Athens, the afternoon of March 24th. Deceased was born January 1, 1812, in Athens Township, below Greens' Landing, on what was known as the old Page farm, a section of land that had been in the Page family for 100 years prior to birth of deceased. His ancestors were always prominent in the business, political and social doings of the sections noted, and did much for the advancement thereof. About a year ago he suffered from vertigo, and towards the close of the summer he was attacked by typhoid fever, from the effects of which siege he never completely recovered. He was the husband of Julia Casandra French (also a native of Athens), who survives him, as do four sons and a daughter. The funeral services were held in Trinity Episcopal Church, of which body he had long been an active practicing member, the afternoon of the 26th ult., the Reverend Mr. Sewell officiating. The committal services were subsequently conducted at the grave, in Tioga Point Cemetery, by Royal Amity Lodge, F. & A. M.

THE members of the Philadelphia Gas Works' Section, National Commercial Gas Association, held their third annual smoker and general entertainment session, in Lu Lu Temple, Philadelphia, the night of the 26th ult. As our informant, in his brief mention of the matter, says: "It certainly was a 'corker.'"

THE Supreme Court of the United States, in dismissing the appeal of the Smith Incandescent Light Company, of Philadelphia, from a decision rendered by the United States Court of Appeals for the Second Circuit, which found the Smith people guilty of having infringed the patents of the Welsbach Gas Light Company, affirmed the judgment of the lower Court sustaining the infringement.

MR. W. K. HARRINGTON, Manager American Meter Company, informs us that the Company has recently made an improvement in its one-tenth cubic foot meter, which is used in connection with the Company's calorimeter. That instrument is now fitted with a bell, which rings automatically at each revolution of the large pointer, indicating the registration of one-tenth of a cubic foot of gas. This arrangement does away with the necessity of the operator having to watch the meter.

A BILL has been proposed in the Missouri House of Delegates, by Delegate Hoffner, of St. Louis, which directs that a representative of all companies supplying gas or electric currents shall respond to all fire alarms, on the first alarm, which representative shall shut off the supply of such currents. A fine of from $100 to $500 is provided for each violation.

"B. V. R.," writing from Ottumwa, Ia., under date of the 28th ult., says: "The dollar gas petition that was to have been started out for signatures on the 26th by Mayor Leeny, who failed to get a second to his ordinance two weeks ago in the City Council, was withdrawn by the Mayor, to make some changes in the measure. The petition is to have an added paragraph, referring to the present franchise that the Gas Company is operating under, ordering a gas rate in keeping with that rating in other Iowa cities of the rank of Ottumwa. The Mayor is virtually alone in this stand."

(*Continued from page* 215.)

opinion that the use of sectional, silica retorts and settings will rapidly supplant the use of fireclay for this purpose. As to vertical benches, I have had no personal experience other than having visited a number of installations abroad and in this country. In vertical benches, where the retorts have any great length, say 18 feet or over, there is, of course, considerable compression exerted on the lower portion of the retort due to the weight of the retort itself, for which reason care must be taken that the temperature at this point of the retort must not be raised to such an extent that the material will be deformed. There is a further consideration between the two systems of verticals—namely, intermittent and continuous. In the intermittent system of vertical retorts we have periodic temperature reductions somewhat analogus to those in the horizontal retort, due to the fact that charges of coal at regular intervals are dropped into the retort, and, due to the large thermal capacity of this body of coal, the temperature of the retort soon after is greatly lowered. On the other hand in the continuous vertical this periodic reduction of temperature does not occur. For that reason it may be practical to run a higher average temperature in the settings and combustion chamber of the intermittent than in the continuous. Exactly what difference in permissible average temperatures at which we can operate the intermittent and horizontal, due to this fact, is difficult at the present time to determine. I think a matter of considerable importance in this question of apparent fireclay failures is a careful consideration of all the actual conditions that prevail from a temperature or combustion standpoint. We hear a great deal about the high temperatures carried in gas benches, and I believe theoretically it can be demonstrated that, with producer gas firing, where we do not pre-heat the producer gas and resort to heating the secondary air by means of recuperators in place of regenerators, it is practically impossible, in either vertical or horizontal benches, to attain a temperature in any part of the setting much in excess of 3,000° F. We do, however, in many instances get the condition of localized heating or concentrated high temperatures which, in my opinion, is the greatest source of trouble and cause for failure of our refractory materials, for the reason that an impinging or scurfing action of a flame, acting directly on any refractory material, is very detrimental and will cause the failure of the refractory at a temperature which otherwise would be entirely safe and satisfactory to carry. I think that some time in future years we shall be able to look back and determine with certainty that a great many of our troubles and apparent failures from poor material have been largely due to localized high temperatures. This localization of high temperature may be avoided in various ways, one of which ways has been by diluting the producer gas with an inert gas. In other words, I think, when we commence to make a leaner or lower B. T. U. gas, and a larger volume of producer gas for a given amount of heating in our benches, it is going to do away with many of our present troubles. As to the quality of refractory material made in this country, we have endeavored to give the matter much study and close consideration; and, in my opinion, there are as good refractory materials made in the United States as ever were abroad. Of course, we must take into account certain facts, that in the foreign fireclay factories the labor conditions are radically different and do not change like they do in this country. The art of selecting and working the clay is handed down from father to son, also, the foreign gas companies have found it expedient and economical to pay for better quality. The gas companies in this country in a way are more or less responsible for the somewhat poorer grade of fireclay material used in their gas benches, as many of them have not been willing to pay for good material, since it requires extra cost to produce higher grades of fireclay. As far as silica is concerned, in my opinion, as good silica, if not the best silica, produced in the world, is made in the United States; and I think we can make good use of the best grades of fireclay here if willing to pay them the necessary price.

The President—Any further discussion on this matter?

Mr. Africa—After the completion of the reading of Mr. Learned's paper the discussion seemed to lead around toward intermittent experiences with continued processes. We have had about 6 years continuous experience with an intermittent process. Mr. Ellis seemed to feel that he was the pioneer in vertical retorts. We had plans drawn in 1906, and the first gas was made April 6, 1908, about 2 years before Providence. You know the history of the vertical plant at Manchester. First, there were some experimental retorts; but the present retorts have been making gas for 1,383 days, not including several months in which the retorts were under a slow fire to make some changes to the iron work. The material was imported clay, from Germany, which proved to be very satisfactory. I do not have with me any results for last year, because we have used the horizontal retorts in connection with the verticals, both being measured by the same meter, but the results obtained from the verticals alone have been published in various proceedings of this Association and the American Gas Institute, so that you can refer to them there. Meanwhile I move a vote of thanks be extended to Mr. Learned for his paper and to the gentlemen who have taken part in the interesting discussion it has brought forth. [Adopted.]

The President—It gives me pleasure, Mr. Learned, to extend to you a vote of thanks for your excellent paper.

Mr. C. A. Learned—I would like to make a few remarks. The time is limited, but the discussion has been a most interesting one to me, I feel perfectly satisfied for what little effort was put into my paper. It seems to me that the discussion brought out a great many valuable points. I did not ask any of my friends after I got back from Europe: "What are you doing with your firebrick? How is it working out?" I simply heard from time to time general remarks. The statements I made were purely on an English basis, and what little I have heard incidentally has proved, what I consider the truth of those remarks, that we have still yet something to learn. I want to make one statement now which is greatly to the credit of this Association, and that is as to the perfect frankness of Mr. C. H. Nettleton, in regard to the Derby settings, and the other gentlemen as well; but Mr. Nettleton made remarks a year ago and we complimented him upon them, because they were so frank. Every man in the gas business wants to know what the other fellow is doing. We are not in competition as we are in different towns, and it is an excellent thing to be able to have a gentleman tell us not only of the advantages but also of the disadvantages. Mr. De Hart said I dodged. Well, if I dodged, the rest of you fellows did not, because you struck the firebrick business just where I thought you would, and it has been a very enlightening subject. One little remark I did not put into my paper. The gentleman with whom I talked in London was Mr. Stein. Mr. De Hart doubtless knows him, and perhaps some other gentlemen also know him. He is a son of one of the Scotch brick makers. He stated that they had remodeled their plant in Scotland, and it seemed to him they had spent about all the money they had in doing it; they had been working for 5 years to get something that would work in vertical retorts satisfactorily. He told me the English specification on which he was working with verticals was 65 per cent. silica, 32 alumina, the rest earthy matter. I don't know that amounts to anything here in America, because the conditions doubtless are entirely different; at least, the coal is different. When I talked with Mr. Glover in regard to that 200 tons of Pittsburgh bagged coal that was brought from America, he was pretty astute. He said, "Yes, Mr. Learned; we had some difficulty in carbonizing that coal. It took a great deal of heat." But I was not bright enough to say, "Did it burn down your benches?" Mr. Burgi said it pretty nearly took the life out of his Glover bench. So we are up against a real proposition in using American coals. Yesterday I read in one of our commercial papers ssme remarks pertinent to the question of candle power. I refer to the No. 2 Metropolitan burner, which is being used in England. This was the statement. Tests with standard argand for the Gas Light and Coke Company in London showed candle powers as follows: 1911, 14.9; 1912, 14.52; 1913, 14.40. As against that, the flat flame burner gave them a candle power respectively in these years of 8.59, 8.25, 8.18. The South Metropolitan Company, using what is called a neat coal gas, had, in 1911, on the No. 2 Metropolitan, an average candle power of 15.7; 1912, 15.49; 1913, 15.51; with the flat flame burner, 9.9; 9.38; 9.44. I said that the "Cheshire Cheese" had poor gas. I guess you would agree with me if you had seen a candle power of 8 to 9 by the flat flame burner. The other companies, outside of the South Metropolitan, were using a mixed gas, so that with the neat coal gas the South Metropolitan at least was obtaining one more candle power than the others. I want to thank the Association for its attention, and, Mr. President, I admit I have been greatly repaid for my efforts.

(To be Continued.)

[Continued from page 198.]

The Installation of Cast Iron Mains.[1]

[Prepared for the Eighth Annual Meeting, American Gas Institute, 1913, by WALTON FORSTALL.]

General Considerations for Repaving.—Many companies find it advisable to contract their paving, and this tendency is increased by the growing prevalence of asphalt in streets and cement side walks. This involves more lamping of trenches, office work in connection with paving bills, and possibly more inspection of paving.

Asphalt.—If the street is much travelled, it is advisable to leave the trench in such shape that it may be driven over during the interval between refilling and repaving, thus dispensing with the expense of

1. Slightly abridged.—EDS.

lamping the trench. When the material has practically all gone back, the concrete of the base (if any) should be thrown in on top of the earth, and then the asphalt pieces laid down. Or the base material may be left in piles and just the asphalt laid back, or the asphalt may be left piled up and the trench surface finished off with the base materials. In most cases, the surface of a long trench cannot economically be made safe for bicycles or motor cycles, and if there is much of such traffic, it will be necessary to lamp the trench until repaved. To hurry the repaving, it is advisable to provide in the contract for decreased prices for all delayed work. For instance, if paving is supposed to be laid within 4 days of receipt of notice, ½ price might be paid for that laid 5 days after notice, ¼ price for 6 days, etc.

In towns without any asphalt plant it will generally be satisfactory to the municipal authorities to substitute a cement finish on a concrete base. this to be replaced as soon as asphalt material is available.

Concrete Base Paving.—Most modern street paving is laid on concrete base, and the tendency is to intrust its restoration to a contractor. Usually the more or less broken masses of concrete form the surface of the trench as left by the rolling gang. Whether such a trench will need lamping depends on its location, the compactness of its top surface, the traffic, etc.

Other Paving.—This includes vitrified brick, belgian block, cobble and rubble, all on sand base. Where only small openings are made, it is best to replace it by the gang that did the opening. In other words, on detached service or lead work, the ability of the gang to do the paving will save lamping and other troubles.

This equipment will be found useful in paving work:

For Paving Small Openings Around Stop Boxes, Etc.

1 Light push cart similar to a plumber's push cart, containing:

1 Spoon bar,
1 Street broom,
1 Small galvanized bucket,
1 6″ Cold chisel,
1 Stop box cleaner,
1 Brick hammer,
1 Caulking hammer,
1 Pick,
1 Sharp nose D-handle shovel,
1 6″ Trowel,
Cement, sand and bricks.

For Paving Service and Small Main Openings.

1 One-horse spring wagon, with top over the seat for the protection of the men, containing:

2 Street bars,
1 3′ x 4′ Mixing board,
1 Street broom,
1 Dust brush,
1 Galvanized bucket,
2 Cold chisels,
1 Paver's straight edge,
1 Curb or radius edger,
1 Wooden float,
2 Brick hammers,
1 Caulking hammer,
1 Concrete knife,
2 Picks and handles,
1 Pitchen tool,
2 Diamond points,
1 Rake,
1 Paving rammer,
1 Dirt rammer,
1 Dot roller for cement,
1 Seamer,
1 Flat nose D handle shovel,
1 Sharp nose D-handle shovel,
1 Sieve,
1 Finishing trowel,
1 4″ Trowel,
1 8″ Trowel,
1 Monkey wrench,
Paving supplies, such as cement, brick and crushed stone, etc.

This equipment is sufficient to do, on a small scale, all kinds of paving except asphalt.

Recording.

A knowledge of the number of feet of each size of pipe comprising the street main system is valuable at all times, and subject to varying degrees of error, is possessed by every company, and almost always includes a map showing the location of the mains by sizes. In many cases, however, there is great uncertainty as to the correcness of the sizes shown, and the distance from the property or curb line is either wanting or incorrect.

The necessity for proper street main records is now thoroughly appreciated, and in what follows is a description of methods of which experience has proven the worth.

In determining requisite street main records the usual condition is that of a system lacking data regarding existing mains, and therefore needing records of maintenance as well as extension work. First the rarer one will be considered, where an entirely new system is being installed.

Field Records.—For the record made on the work, a Transit Book is very convenient. This is 4½″ x 7½″, has about 60 leaves, ruled with horizontal and vertical lines. In making the records, a zero point may be taken at the beginning of the line, and all locations along the line given with reference to this zero. When the proposed line of a main has been measured over, and the points of reference noted, any portion of the main as laid can be quickly shown on the record, whether gaps occur or not. The detail needed to properly locate the main on a map, and to easily find it when occasion requires uncovering, depends upon the number of changes in depth and alignment. The depth to top of pipe and the distance from curb, or property line, should be given every 100 feet, and if these change, at enough points to define the line. A single line will suffice to show the pipe. All special castings, branches or bends, should be accurately located, the length of each special being considered to be the distance between the faces of its bells, or between the bell of adjoining pipe or specials. A bracket mark, "[," at right angles to the length of the pipe is an easy way of representing the face of each bell.

When dividing property lines, intersecting roads or streets, etc., are not at right angles to the main, these points should be located by their intersection with whatever line is being used as a base, and not by their intersection with the main itself. With all specials thus located from the assumed zero point, the amount of straight pipe laid at any moment may be easily calculated, and this is often easier than adding up the work by days. If the depth is changing rapidly, or the pipe is not paralled to the reference line, it must be measured along the pipe itself, and not on the reference line between the stations marking the beginning and end.

If there are many specials close together the scale sufficing for the ordinary portions of the line will prove too small. Therefore, the scale ought to be increased at these points, or a detail sketch on a larger scale should be shown elsewhere.

While, as a rule, the depths indicate which way the line is dripping, it is much more convenient to indicate the direction of drippage by an arrow, parallel to the line.

A record of other structures encountered is generally of sufficient value to warrant the slight extra work involved; and increases in value as underground conditions become more congested. If the foreign structures are mains, they can be indicated in the same way as the main being laid; if conduit, and rectangular in section, a line may be drawn indicating the nearest upper edge to the main being laid. This, with the distance from the centre of the main, the breadth and depth of the conduit, and depth below the street level, locates it completely.

If is of value to indicate the date of each day's work between arrow heads, located at the proper points. Where, for any reason, the work is discontinuous, this graphical record of dates may prove quite valuable. Fig. 22 is a page record.

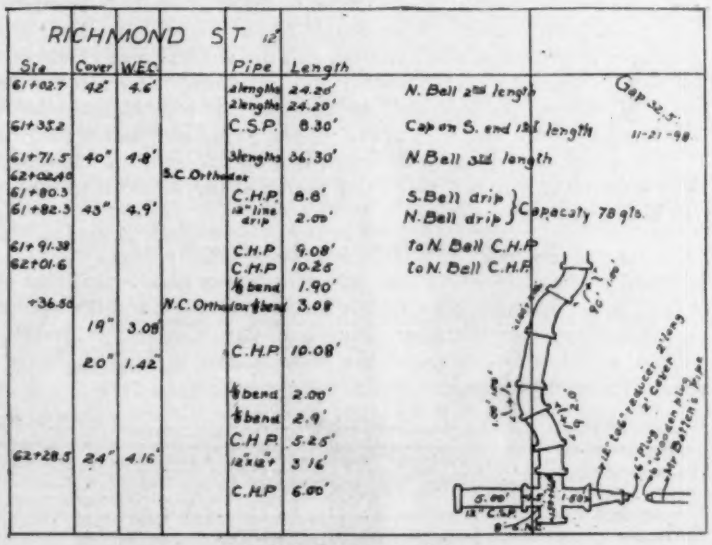


Fig. 22.—Transit Book.

Reports to Office.—Where the company is small no work progress report to the office is needed. If a daily or weekly report is wanted the form Fig. 23, should be used, printed on a postal card where mailing is necessary. This information is particularly valuable on a long line, and gives the office knowledge of conditions of the work.

Permanent Records.—For all large and many small cities, atlases may be obtained with plates on scales of from 200 to 500 feet to the inch. There are very few towns of which some maps are not obtainable, and in the country there are those of the Geological Survey. No company should make up its own map except as a last resort, for

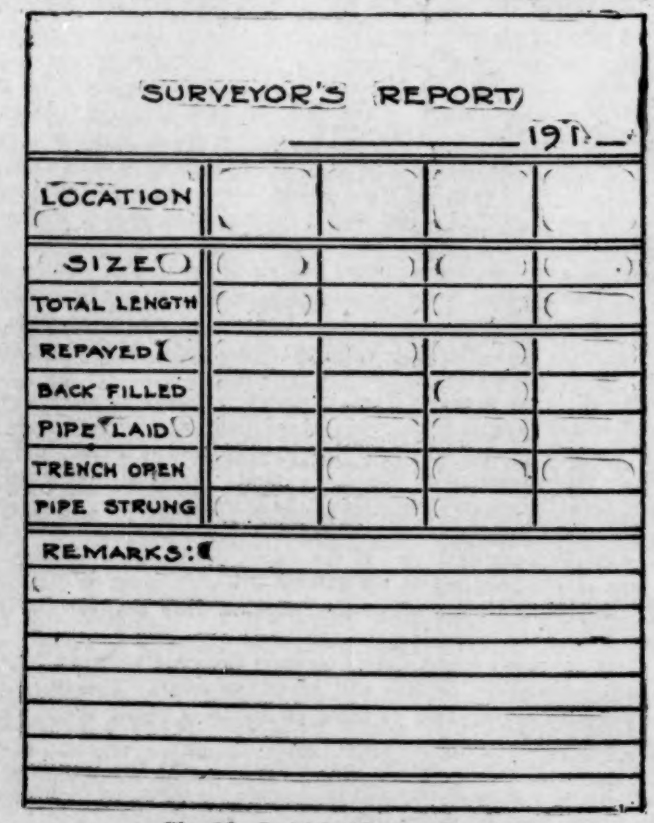


Fig. 23.—Postal Card Progress Report.

map work easily runs into great expense. On the map a line will indicate the general location of a main, and by its color the size, but the scale will be too small to indicate specials, drips or any details. For such details, a different set of records is wanted. When the field book is used, the map should indicate book number and page containing the record of every block, or 500-foot section of main. If the field book information is transcribed, the record should be on tracing cloth, or thin bond paper, from which blue prints may be made for the working file, and the originals kept in a safe. Sheet should be about 7″ x 18″, and give the main in plan and elevation, and be a faithful transcript of the field record in every point necessary to give the location of the pipe and other structures encountered. The drawing need not be to scale, and thus more space given to points where many specials are used. Sheet should be numbered and numerically arranged in groups of one hundred, and the general map would have its number opposite each block, or unit distance. Thus, to find any detailed record, it would only be necessary to look at the map, see the block number, and turn to the proper group of detailed records.

If it is necessary to send a record out on the street, a convenient way is to make a rough free hand sketch of the location wanted, or the blue print may go out.

Records for New and Existing Mains.

Small Company.—For a company selling less than 50 millions annually in a town with a few underground structures, and few specials in the main system, the most convenient way to record information of old mains is by the use of the book shown in Fig. 24. This is

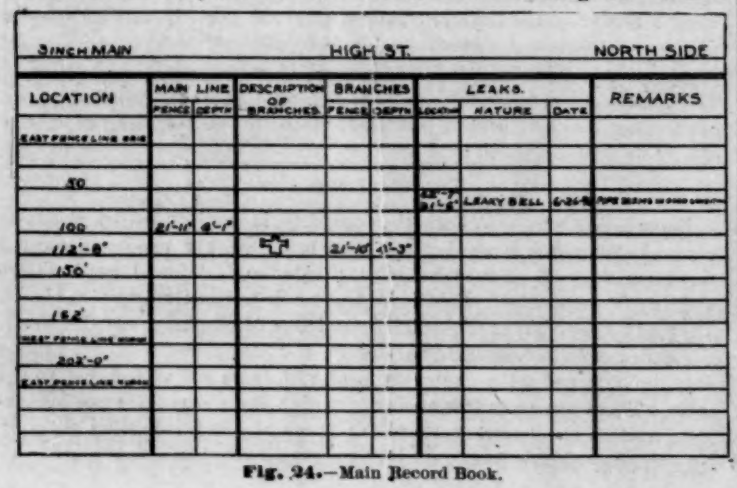


Fig. 24.—Main Record Book.

written up for every street on which mains were known to be, and distances shown between intersecting streets. As illustrated "O" is the east fence line of Erie, and "202" the east fence line of Huron, which is also taken as "O" for distances in the next block. One line of the book is allowed for every 25 feet, and any work done on a main, or information gathered by uncovering it, is entered on the proper line. If there are very many openings, this book would not provide enough space.

To record new mains use the field book record Fig. 22.

Large Company.—It is quite feasible to record all new mains by the field book system, the number on the general main map telling where to look for any record. A number opposite the block would indicate that such record was made and would be found as a blue print in the file indicated. The absence of a number would mean that the record was on a sketch card in the proper alphabetical file.

The blue print record gives a continuous record of the main, but it does not lend itself to changing conditions, and this is one of the objections to using it in large cities, where the installation of various underground structures may cause many changes in main locations.

(To be Continued.)

Suggestions for Rate Making.[1]

[By Dean W. G. Raymond.]

Any public-service plant owned by a municipality, gives a certain service for which the whole taxable public should pay. A lighting plant lights the streets, a water works furnishes water for fires, for street cleaning, sewer flushing, and other public uses. It seems to be proper that all property served, or to be served, by water mains, gas mains, or electric light wires, and street lights, should pay a portion of the return that must be collected to cover the items of interest, cost of operation and depreciation The part that such properties should pay should be levied as a separate item in the tax, and placed to the credit of the public service plant for which the tax is levied; and it should be divided into three parts: (1) A portion levied on every taxpayer for the general service to all citizens; (2) a portion levied on all property enjoying potential or actual service because of the existence of the service lines in its vicinity; (3) a portion paid by users for the actual service rendered to them exclusively.

Any municipally owned plant should pay the items of interest, operating expense, and depreciation from the start. Since the number of customers and the output sold in the early years of the plant will be relatively small, it is suggested that in the beginning a relatively larger portion must be borne by the community as a whole for actual public use and potential private service, than will be proper in later years. Then a larger output will be sold to individuals, and the common tax reduced.

The following is suggested as one way to apportion the amounts to be paid by the public at large, and the individual users. A water works is taken specifically and some modification of terms is needed in transferring the plan to other utilities:

Divide the loss by leakage between the users as a whole and the community as a whole, in proportion to the quantities measured and that estimated for fires and streets, and augument the total private and the total public use thereby. A more or less arbitrary portion of the whole expense may be levied against real property served, or to be served, by the plant. What remains should be divided between the public at large and individual consumers, in proportion to the total quantity of output used. That paid by consumers for use should be arranged on a sliding scale, so that the larger users shall pay a lower rate, since the cost of service to each user is not in proportion to the output used, but is less per unit as the number of units is greater.

For water works in small cities, the portion to be paid by the general public for fire protection is larger than would be obtained by considering only the amount of water used. Mains must be larger than required for ordinary consumption, in order to furnish large quantities of water in short periods for fires. For the same reason, pumps must be of greater capacity than necessary for the domestic and business service. These differences may be estimated and the interest and depreciation on them should be included in the general levy on all taxable property.

If the municipality prefers not to engage in the business but wishes

1. From a paper read at a "Municipal Lighting Day" convention, State University of Iowa, Iowa City.

to allow some person or corporation to do its business for it, should there be any difference in the allowed rates? I think there should to the extent that the individual or corporation must be paid a wage for doing the business. This wage ordinarily will take the form of a larger return on the capital invested than mere savings bank interest and should be interest and profit on the invested capital. A business man in any private commercial enterprise expects to earn interest on his invested capital, wages for his time and energy in directing the business, and an extra profit as well. It may be said that he ought to expect to earn only interest and wage, but scarcely anyone will deny that the wage should be commensurate with the risk and magnitude of the enterprise. No one would expect a man managing a business of millions of dollars yearly to be satisfied with the same wage as one conducting a grocery doing an annual business of a few thousands. And no man or group of men can be expected to undertake public business, unless a wage is permitted that is commensurate with the risk and the magnitude of the undertaking. The capital invested will largely measure the magnitude of the undertaking, but not always. A bank with a comparatively small capital may do a very large business and consequently earn a very large dividend on its capital, though not an exorbitant percentage of profit on the business done. Just so, by fortunate location and wise planning, one public enterprise may do a large business on a relatively small capital, compared with another less favorably located or less wisely constructed. Hence, it seems to me the profit of wage allowed the corporation should be a percentage of the cost of operation, it being understood that there will be supervision to the extent of preventing padding this cost, and an agreement whereby this profit may be larger as the cost per unit is smaller.

The franchise should be such as to reduce the risk to the corporation to a minimum. It might even be agreed that in return for good service with a plant reasonably well designed and operated, that the company should be guaranteed against loss from the start, by rates much the same as for a municipally owned plant. Such a guarantee would lessen the risk and reduce the interest rate on the company's securities, and hence the total rate that the public should pay.

Thus a gas company might be allowed a standard rate of $1 a 1,000 cubic feet; and limited to an 8 per cent. dividend on its stock, with a proviso that for each cent of reduction in the rate it would be allowed a small increase in its dividend. Such a practice obtains in London and in Boston, though the figures are not those cited. Of course, this implies a public control of capital.

The one item that is really difficult to determine is "replacement" or, as it is generally called, "depreciation." It has been suggested that the sum laid aside annually for depreciation or renewals be that which at compound interest would total the cost of the plant at the end of its life. This may be questioned in the case of a municipal plant, and it is certainly not proper for a privately owned plant. Renewals of parts of the plant will be required in a few years and will continue at intervals during the entire life of the plant, some items being renewed several times during the lives of other items. Therefore, it is not feasible to tie up the depreciation allowance at interest unless, possibly, the lives of each class of items, short-lived and long lived, have been considered separately and depreciation allowances aggregated accordingly. In a privately owned company, it is not proper to require them to place the depreciation allowances at interest in order to realize the full investment by the time the plant has been entirely replaced. Rather the cost of each part should be returned to the investor by the time its life is ended. We should regard the depreciation allowance in the rates as a direct return of capital, and should so arrange that it will be less at first and more at the last, since renewals are likely to be greater as the plant grows older. But it is also desirable for the rate making that the total allowance for interest and renewals shall be practically uniform from year to year. The committee of the American Society of Civil Engineers, on valuation of public utilities, has devised a plan, under which the total depreciation payments made during the life of the plant will equal the whole original investment, and the subtractions from capital will reduce the original capital to nothing at the end of the life of the property. If replacements have been prompt and the plant has been maintained at 100 per cent. effectiveness, it now represents just the capital originally put into it, and the payments from the public should go on as before. If it were possible to conceive of such a thing as the gradual and finally complete destruction of the plant by reason of its use and the failure of the company to reinvest in it the sums allowed for depreciation, and this result should obtain at the estimated end of the life of the property, there would be no further service, and no further payments due. The company would have received interest on all the capital actually invested in the plant at all times up to the end of its life, cost of operation; profit or wage for its service; and also the capital it had originally invested. It would thus stand even, having received interest on its capital while in use, and pay for the service given. Of course, no such thing actually could happen because if the plant were allowed to run down, the service could not be maintained and would cease to be efficient long before the end of the life of the plant. The property must be considered to be a permanently continuing enterprise.

If the same rate of interest is used for return on capital and for depreciation allowances, the aggregate annual payments will be equal. If the interest allowed on capital differs from that allowed in computing depreciation, the payments will not be quite uniform, and if the interest on capital is the greater, the aggregate will be somewhat greater at the first than at the last. This is undesirable, but cannot be avoided under the plan which allows profit in the shape of large interest on invested capital. I suggest that the interest be the same on capital and depreciation allowances, and that profit or wage be computed on cost of operation.

The Eye as a Judge of Uniform Illumination.

By J. R. Cravath, in *Electrical World.*

Although it is commonly known to illuminating experts that the eye cannot readily judge small differences in illumination when the surfaces illuminated are not close enough together for the contrast to be evident, few fully appreciate the great differences in illumination that will be passed by the casual observer as practically uniform. For this reason it is believed that the test results outlined below will be of interest as showing how far from uniform the illumination may be and still appear uniform to the ordinary observer.

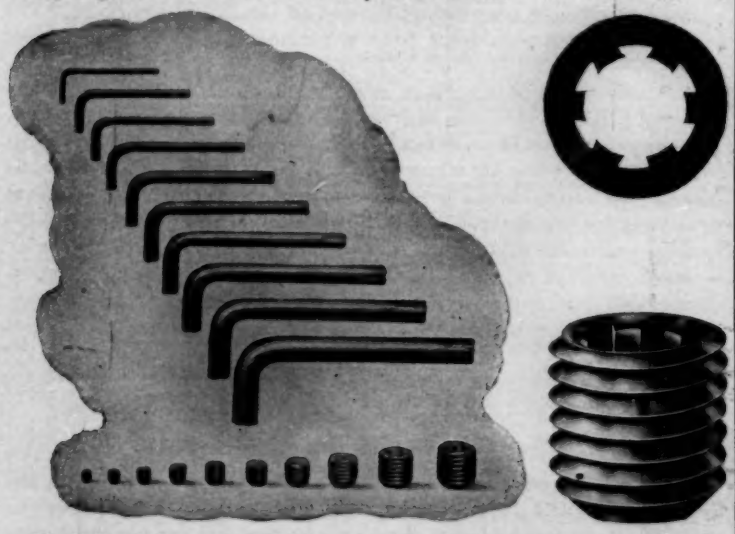
Dearborn street, Chicago, to the ordinary observer at night has nearly uniform illumination on its road surfaces. The lighting is by flame arc lamps of the type now standard for Chicago, with vertical electrodes. There is an arc lamp on each electric railway pole, hung on a bracket extension from the top of pole, so that the arc is about 25 feet above the street level. The poles are from 110 to 125 feet apart along both curbs, and the street is 80 feet wide. The unusual height of the lamps and their broad distribution of light give the effect of a uniformly illuminated street surface. Another casual test for uniformity made by the writer was that of looking at the street surface while standing in a street car moving along the street, the lamps themselves being then invisible. By looking intently at the street surface as the car passed along the variations in brightness seemed very small. After making these observations with the eye the facts were investigated by photometric measurements. The horizontal illumination determined with a Sharp-Millar photometer at 5 points along the curb line showed a variation of fully 10 to 1 in foot candles between the points under the lamps and points midway between them. This result brings out forcibly the inability of the eye to judge differences in illumination, unless the differences are in contrast side by side like sharp shadows. In the case just described the gradation from 1-foot candle to about 0.1-foot candle midway between lamps is so gradual that no one but an expert would detect it, unless the attempt were made to read a newspaper or do similar close work with the eyes while passing along the street. The latter test would show considerable difference.

Another illustration of the inability of the eye to judge differences of illumination is in the case of shadows with indirect lighting. The writer once tested the relative density of the shadow of a person's head on a desk top in a room lighted with direct units, and later lighted with a similar number of indirect units, the point of maximum shadow being selected in each case. With the indirect it was only after very close observation that the point of greatest shadow could be found, as apparently there was very little shadow, while with the direct system no difficulty was found in locating the point. Nevertheless, photometric tests showed that with the indirect system the illumination at the middle of the shadow was reduced 45 per cent. because of the shadow, while with the direct system the illumination was reduced 51 per cent. because of the shadow. The pronounced character of the direct shadow was due therefore largely to the fact that it had a sharp edge, while with the indirect system there was a gradual merging from the shadow to the edge, and the shadow was therefore indefinable.

The practical lesson of these observation is that satisfactory illumination is not necessarily uniform and the variations permissible are much greater than usually thought. In planning illumination the avoidance of sharp or sudden contrasts will compensate for much lack of uniformity.

New Methods and Appliances.

A Safety Set Screw.—The "Safety first" movement has progressed so far that great attention is now being given to changing the design of machinery to protect human life, and the elimination of set screws with projecting heads is one of the things upon which safety engineers and insurance inspectors insist.



The Bristol Company, Waterbury, Conn., has recently put on the market the new line of "Bristo" Patented Safety Set Screws shown in the accompanying illustrations. They are manufactured under the Goodwin patent of October 14, 1913, and the patented features include 6 dove-tailed slots inside the hollow head of the set screws, and corresponding flutes on the outside of the special wrenches used with them. The dove tailed design is such that when these set screws are set up hard with the special wrench, there is not the usual tendency to expand and crack the hollow head, and from the angles of the surfaces of the slots there is a tendency for the wrench to contract or compress the head of the screw. They are made in a great variety of sizes, and a special treatment process used makes the screws glass hard on the outside and extremely tough on the inside; samples in actual test have been found 100 per cent. stronger than the old hexagonal style set screws.

Spraying Molten Metals.—The Schoop process, for coating objects by directing a fine spray of molten metal against them, has been improved by the introduction of new apparatus, which is described in the Revue de Metallurgie, Paris. The machine is called a pistol-syringe. The metal wire is fed automatically to it, and melted by an oxyhydrogen flame, or of oxygen and illuminating gas. The melted metal is sprayed by compressed air, which also runs a small turbine that feeds the wire. The most diverse metals can be used—lead, tin, zinc, aluminum, copper, brass, etc., and the inventor anticipates a successful use of glass and enamel. Very thin coatings can be produced for purely decorative purposes, or thicker ones that can be polished, and if desired, removable coatings, several millimeters thick, for reproducing, by casting, medals, plates for engraving, etc. All kinds of objects can be metallized by the process.

Recent Patent Issues.

Prepared for the American Gas Light Journal by Royal E. Burnham, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,089,503. Valve for Lighting Fixtures. V. H. Slinack, Philadelphia, Pa., assignor to Pennsylvania Globe Gas Light Co., same place.

1,089,504-5. Inverted Incandescent Gas Light. V. H. Slinack, Philadelphia, Pa., assignor to Pennsylvania Globe Gas Light Co., same place.

1,089,730. Gas Meter. H. H. Sprague, Bridgeport, Conn.

1,089,869. Globe or Shade and Holder Therefor. D. A. Ripley, Connellsville, Pa., assignor to Ripley & Co., same place.

1,089,926. Apparatus for Manufacturing Gas. E. C. & L. B. Jones, San Francisco, Cal.

Items of Interest
FROM VARIOUS LOCALITIES.

Mr. James Sheldon Cummins, senior member of the law firm of Cummins, Stearns and Milkewitch, also Vice-President, Senior Counsel, Director and one of the founders of H. M. Byllesby & Company, died in his residence, "The Bryson," Chicago, the evening of Monday, the 23d ult. Born March 22, 1857, in Upper Province Township, Delaware County, Pa., he was educated in Swarthmore College, was admitted to the bar (Pennsylvania) in 1882, his first practice being in Media, Pa. In 1891, at the instance of the Thomson-Houston Electric Company, he settled in Chicago, acting as Counsel for that Corporation until its interests were merged (1893) with those of the General Electric Company. He continued to act as of Counsel for the merger concern. Funeral services were held in Chicago (St. Paul's P. E. Church), the 25th ult., and committal services were read in St. Andrews Church, Mount Holly, N. J., the 26th. The general offices of the Byllesby Corporation were closed all March 25th to enable the officers and employees to attend the funeral.

"B. M. T.," writing from Westboro, Mass., under date of March 27th, says: "This out-of-the-way place, of course, is not a very large spot on the gas map, nevertheless, we have a pretty good artificial lighting service by a certainly well-managed corporation known as Westboro Gas and Electric Light Company. This month the Company has carried on a campaign for office and store window lighting, and the second gun of the series was charged in the chemical and drug shop of C. E. Saunders, Ph. D. The shop of itself is a very well-managed one, and the efforts of the Company to exploit in the show windows thereof how the things carried in stock could be made to look well was a blazing success. That is, if success may be measured by the numbers attracted to the show. To the rear of the windows (deep bay type) banks of absorbent cottons, packages of lint, rolls of tape and the like, were properly displayed by means of suitably placed lights, and in front were shown good examples of the drugs used in the compounding of prescriptions, etc. These, too, were properly illuminated. A large microscope was also properly 'incorporated' in the display, coupled with a good assortment of test tubes, etc. Several of the drugs shown were in the crude state, and all were properly labelled. The exhibition was an undoubted success."

"The new gas plant at Lykens, Pa., is virtually in active condition, and the generating division is under the capable direction of Charles Hower, formerly of Shippensburg, Pa. Mr. Crawford, of Baltimore, has organized the sales' division of the Company, and has, properly displayed, in suitable office premises, a complete line of lamps, burners, shades, ranges, hot water devices and the like.—B.V."

Messrs. Longstretch, Richards & Co., of Cincinnati, have purchased the $200,000 bonds (5's) that were offered for sale by the settlement of Rocky Mount, N.C., the proceeds from such sale to be devoted to the erection of a gas plant, to improve the roads, etc. The Cincinnati bankers paid a sum to net the settlement $197,000, the terms of payment to be these: Twenty-five per cent. cash; the remainder to be paid on an installment basis of 3, 6 and 9 months, the purchasers to pay interest on the deferred sums at a rate equal to that named in the bond.

Mr. H. H. Cari, General Manager of the Carolina Power and Light Company, which corporation owns the lighting plants of Durham, N. C., has announced a reduction in the selling rates for gas (effective the first inst.) that is equivalent to an all-round cut of 20 per cent.

"D. E. N.," writing from Chicago, under recent date, reports that, beginning the first ult., Mr. C. R Pierce, a graduate of the Electrical Engineering Department, University of Illinois, and in the employ of the Peoples Gas Light and Coke Company, Chicago, as expert of electrolysis, took over a like position with the Board of Supervising Engineers, Chicago Traction Company, of which body Mr. Bion J. Arnold is Chairman.

Mr. E. L. Callahan, the clever General Manager of the New Business Division of the H. M. Byllesby Corporation, early in March made public the fact that Mr. Robert Montgomery had been appointed new business manager of the Louisville (Ky.) Gas and Electric Company. Also, that Mr. R. E. Flower, formerly in charge of the new

business division of the Mobile (Ala.) Company, has been appointed assistant to Mr. Flower at Louisville. Right after the appointments were made public the members of the Federal Sign System, in Louisville, tendered a dinner in honor of the new appointees, which dinner was splendidly served in the Hotel Henry Watterson.

THE Conso lidated Gas, Electric Light and Power Company, of Baltimore, has added to its emeritus roll the names of 5 additional employees who have served it for periods ranging from 21 to 41 years. Their names were placed on the roll of honor, and were presented with a silver diploma, the Company's honor badge. Of course, they share in the pension fund until death claims them. The veterans are:

Name.	Years of Service.
Robert Wright	41
Robert J. Kerr	40
W. H. Gallagher	37
J. H. Griffin	36
Jas. Rodgers	21

The correspondent who forwarded the above to us added this interesting bit of history respecting the man who heads the list: "Mr. Wright spent practically his entire 41 years of service at Spring Garden Station, where he was engaged as a fireman and gas maker. He was originally employed by the Gas Light Company, of Baltimore, in the old days of coal gas making, when only the best specimens of physical manhood could stand up under the demands made on their strength, and without disparaging the strength of the others of herculean type who were engaged in similar work, Mr. Wright was said to have been one of the strongest men in the plant. He was later engaged in water gas making, operating the Wilkinson generators, and was always a reliable and capable workman. Previous to entering the service of the Gas Light Company, Mr. Wright was engaged in the service of the United States Government in the Naval Department. He was born February 14, 1849."

MR. W. H. BARTHOLD, Operating Engineer of the Hodenpyl-Hardy Corporation, sailed from New York for Bermuda, per "The Bermudian," last Wednesday, where he proposes to spent the current month recovering his strength, which a rather severe illness managed to sap considerably.

A CIRCUIT COURT jury, sitting in Newark, N. J., on the 26th ult., returned a verdict against the Public Service Gas Company, of New Jersey, damages being thereunder awarded to Mr. Thomas Jones, a florist of Short Hills, in the sum of $3,200. Jones averred that, through the negligence of the Company, gas escaping from one of its street mains penetrated the subsoil of his hot house, to the utter destruction of 6,000 plants of the orchid nature. He asked damages in the sum of $6,000.

A CORRESPONDENT in Hudson, Mass., forwards the following under date of March 28th: "In the case of Howard D. McGinnis, of Marlborough, vs. The Marlborough-Hudson Gas Company, tried in the Supreme Court, East Cambridge, before Judge Stevens and a jury—trial of the case occupied about 4 days' time—the jury found that plaintiff's cellar had been flooded through the blowing out of a loose stone or the fracture of a ledge of stone near the house of plaintiff. That the excavating was done under the general supervision of the defendant's engineer, and that the contractor who was laying the pipe, was not negligent, and that the damages suffered by plaintiff were equal to $612.50. When these findings were returned to Judge Stevens, he declared that he would report the case to the Supreme Judicial Court, whereupon if such Court decided that Judge Stevens should have submitted the case to the jury, judgment would be entered for the plaintiff for $612 50; if not, judgment would be inscribed for defendant. The action was brought for damages caused to the plaintiff's premises, April, 1913, from water which ran along the trench, in which the defendant had placed a gas pipe, following such trench, and hooking to a pool of water resting in a hollow on the side of road opposite plaintiff's premises. Defendant contended that the contractor, who put in the pipe and blasted the ledge, was the real one in default; but the Court held that, if anyone were directly liable, that one was the defendant."

THE last "Lamp Sale," by the Scranton (Pa.) Gas and Water Company, was a swift success. We will not say anything about the prices realized for such lamps, but we do know that the Company, having had the matter freely advertised in the local papers, opened the sale at 8 A.M., March 28th, and at 11 A.M. the last lamp in stock was passed over the counter. The lamps sold numbered 979.

THE expense, in connection with the recent election to determine whether the franchise proposed for the Omaha (Neb.) Gas Company should become operative, amounted to $5,386.20. Of course, it was borne by the Company.

IT is said that the new gas plant that is being erected by the Kennebec (Me.) Gas and Fuel Company on Hayden Brook, for the supply of Waterville and adjacent settlements, will be completed by June first.

"THE annual reunion of the employees of the New Britain (Conn.) Gas Light Company was held, the evening of the 24th ult., in Bardeck's Hall, which, of course, was all dolled up for the occasion. An excellent dinner was served and enjoyed, with Mr. A. J. Sloper in the 'Seat of the Mighty,' that is, in the Toastmaster's chair. Amongst those who responded to his invitation was Manager H. T. Sloper, and the department heads. The musical matters were ably done by the Tuxedo Mandolin and Guitar Club, of Hartford; and another whose efforts at entertainment were praiseworthy, was Mr. F. A. Schneider, of Wesleyan.—B. L. B."

AT the annual meeting of the shareholders in the Peoples Gas and Electric Company, Oswego, N. Y., the plans to increase the capital stock were indorsed, and the following Directors were elected: C. H. Tenney, H. C. Warren, B. E. Manson, A. B. Tenney, F. A. York, R. A. Downey, J. T. Mott, E. M. Bradley and H. P. Wood.

THE new storage holder (6,000,000 cubic feet capacity) which was built by the Riter-Conley Company, of Pittsburgh, Pa., to the order of the Philadelphia-Suburban Gas and Electric Company, Chester, Pa., and which was put into commission a fortnight or so ago, has not given its builders or owners a single anxious moment. It is an imposing structure.

"B. M. F.," writing from Portland, Ore., under date of the 24th inst., says: "We will soon know whether or not the ordinance prohibiting the construction of a gasholder in Portland, at a point within 250 feet of a church, school or residence, shall be rescinded, as recommended to Council by Commissioner Dieck, of the Department of Public Works. If the order to rescind is issued the Portland Coke and Gas Company will proceed with the construction of its proposed holder, the storage capacity of which is rated at 3 millions cubic feet, at the junction of Tenth and Clinton streets. The vessel is intended for better gas service to the residents of the city, in the district south of Sullivan Gulch. Feople in the named vicinity have filed a protest with the Council against the rescinding of the ordinance, basing their remonstrance on the danger to health, the depreciation of property and the menace to life that the actual working of a gasholder implies. Commissioner Dieck, in compiling his report on the matter says that the proposed location of the holder is within a district rapidly developing into a manufacturing center and is speedily losing its character as a residence district; further, it would be difficult to make choice of a better site, remembering the purpose or object thereof. Again, gasholders and tanks, properly constructed and maintained, need be neither menace nor a nuisance to any community, and, by fitting treatment of the surroundings, need not cause any offence to the eye. He also reviewed the provisions of the ordinance, declaring that if these were strictly inforced they would cause the discontinuance of every gasholder in the city, and that if the ordinance stands in its present form he will be in duty bound to enforce it, bringing about the eventual removal of the tanks. As a final reason he declares that the construction of the proposed holder and tank is, in the broadest sense, a public necessity."

MR. C. STANLEY NEIMAN has resigned as Superintendent of the municipal lighting plant, operated for some time more or less spasmodically by the authorities of Easton, Pa.

M. A. DURRSCHMIDT is contracting for the Shelton division, the Derby (Conn.) Gas Company, a model coke storage plant. It is 20 by 30, of expanded metal lath, in stucco finish.

Utilities Commission News.

SECRETARY ILLINOIS COMMISSION.—Mr. Charles N. Hebner has been appointed Secretary of the State Public Utilities Commission of Illinois. The salary attached to the position by law is $5,000 a year. Mr. Hebner is 37 years of age and has had practical experience as an accountant in public utility work, having been employed by the Chicago Railways Company in that capacity.

AUTHORITY OVER SECURITIES.—The Massachusetts Gas and Electric Light Commission has asked the legislature to give it final jurisdiction over the issuing of securities by utilities under its supervision. They wish to avoid such reversals of their decisions as that in the recent Fall River Gas Works Company case, where the Supreme Court of the State required the Board to authorize a stock issue which had been refused on the ground that it was inconsistent with the public interest. Under its provisions no securities could be issued save with the approval of the Board as a court of last resort, no court appeal being allowed in case of an adverse decision. The bill is designed to prevent the accumulation of unduly large surpluses and the issue of new securities as virtual stock dividends.

OHIO COMPANIES MUST TEST ALL METERS.—By proposed order of the Ohio Public Utilities Commission, every gas company must equip itself with a prover and test all meters, but a committee of gas men will be called by the Commission to discuss the orders before they are finally put into effect.

A gas meter which does not run more than 3 per cent. fast when passing 6 cubic feet an hour, is considered correct, according to the proposed orders, and meters must be tested once in every 4 years. A fee of $2 may be charged the consumer who asks a test of his meter, to be refunded if the meter is found to be more than 3 per cent. fast. The standards for heating value for natural gas is set at 800 British thermal units, and that of artificial gas at an average of 550, and the larger companies are compelled to equip themselves with a calorimeter outfit.

RIGHT OF COMMUNITY TO ENJOY ITS NATURAL ADVANTAGES.—"One feature of 'the saving over coal method of determining the value of a water power' should not escape attention. We live in a region remote from the coal fields, the cost of transportation is heavy, and the price of coal higher than in almost any other part of the country. On the other hand, ours in a mountainous State, with many streams having a large fall and furnishing an abundance of water power, much of which is still undeveloped. If we adopt the policy of valuing water powers in rate and capitalization cases by capitalizating their saving over coal, the people of the State are left subject to all the disadvantages attendant on remoteness from the coal mines, while enjoying no advantage from living in a region abundantly supplied with water powers. A fair value of a water power in New Hampshire cannot be a value which takes no account of our natural resources, and makes electricity produced by water as expensive to the public as if produced by coal."

"We cannot, on any theory, adopt as conclusive this method of valuation." Quoted from ruling by New Hampshire Commission.

CALIFORNIA COMMISSION DEFINITIONS.—"Original cost" is defined as original book cost, being the actual expenditures chargeable to the capital account, in accordance with Interstate Commerce Commission accounting rules. "Reproduction value" is held to be the estimated cost in cash of acquiring the operative right of way and other real estate, and reproducing, in the condition in which it was acquired, the other physical property of the company in California, plus overhead expenditures for engineering, law, commissions, etc. "Present value" is defined as reproduction value, less diminution in value of the physical elements of the property through age, obsolescence, inadequacy, etc., plus appreciation where found. The term "depreciated reproduction value" might be used interchangeably with this.

The Market FOR GAS SECURITIES.

Consolidated shows a gain of a point, as the net result of the week's trading. The offerings, however, were very few, indeed the total trading for the 6 days did not exceed 2,500 shares. The opening to day (Friday) was 133½ to 133¾. The bond inquiries continue, and quite some active exchanges were made, at better figures than those shown in an average going back 4 years.

The quotations for Brooklyn Union remain unchanged—126 to 128, and there is actually no trading in the securities—either stocks or bonds.

The end of the fiscal year (1913) of the Columbia Gas and Electric Company, including the Union Gas and Electric Company, which corporations control the lighting situation in Cincinnati, shows a total of $5,497,959, or a gain of $342,514. The net, after all charges, is a surplus of $219,121 for the year, as against a deficit of $1,876 in 1912.

The Newton and Watertown (Mass.) Company has declared a quarterly of 2 per cent., which is a reduction of ½ per cent. from the previous quarter. The Trustees of the Massachusetts Gas Companies have declared a regular quarterly of $1.25, payable May first.

The National Gas, Electric Light and Power Company's of 1½ on the quarterly, and 1 on the common, have been declared, both payable since the first.

The H. M. Byllesby & Company corporation, amongst other declarations, has declared a quarterly of 1¾ per cent. on the preferred of the Western States Gas and Electric Company, payable the 15th inst. The Associated Gas and Electric Company quarterly of 1½ is payable the 15th inst. The Washington (D. C.) situation is gradually clarifying, and it is just possible that some sensible procedure will blot out in quick order at least one of the important errors registered in the Leiter regime. On the Exchange yesterday $1,000 refunding 6's, Lacledes, were sold at 100⅛.

GAS STOCKS.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

115 BROADWAY, NEW YORK CITY.

APRIL 6.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co.	$99,815,500	100	133¾	134¼
Central Union Gas Co.—				
1st 5's, due 1927, J. & J.	8,500,000	1,000	101	108
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	101	104
Mutual Gas Co.	8,500,000	100	157	157
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	99	101
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	59	62
1st Mtg. Gold Bds. 5 p. ct.	1,500,000	—	98¼	100½
New York and East River—				
1st 5's, due 1944, J. & J.	8,500,000	1,000	103	105
Con. 5's, due 1945, J. & J.	1,500,000	—	98	100
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	100	102
Standard	5,000,000	100	102	104
Preferred	5,000,000	100	93	94
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	90	95
The Brooklyn Union	15,000,000	1,000	126	128
1st Con. 5's, due 1948, M. & N.	15,000,000	—	102	103
Yonkers	299,650	500	190	—
Out-of-Town Companies.				
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	2	5
Bonds, 5's	5,250,000	1,000	50	60
Binghampton Gas Works	450,000	100	—	—
" 1st Mtg. 5's	500,000	1,000	97	100
Capital, Sacramento	600,000	50	—	25
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,500,000	1,000	104	106½
Consolidated Gas Co. of N. J.	1,000,000	100	15	—
Con. Mtg. 5's	976,000	1,000	94	96
Bonds	75,000	—	—	100
Cincinnati Gas and Electric Co.	29,500,000	100	17	69
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus Gas Light & Fuel Company	1,682,750	100	65¾	66¼
Preferred	3,026,500	100	33	35¾
Consolidated, Baltimore	13,460,084		118¾	119
Mortgages, 5's	3,400,000		—	—
General Mortgage 4½	10,661,000		—	—
Con. Gas Co., Baltimore City, 4½	2,751,000		—	—
Detroit Gas Co., 5's	381,000	1,000	75	80
" Prior Lien 5's	5,619,000	1,000	97	100¼
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,350,000	1,000	100	101
Essex and Hudson Gas Co.	6,500,000	—	138	138
Hartford	750,000	25	190	200
Laclede Gas Co., St. Louis.	10,000,000	100	97	100
Preferred	2,500,000	100	—	102¾
Bonds	10,000,000	1,000	102¾	103
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	120	120
Massachusetts Gas Companies, of Boston	25,000,000	100	90	90¾
Preferred	25,000,000	100	93¾	94¾
Madison Gas and Electric Co.				
" 1st Mtg. 6's	400,000	1,000	106	
Montreal L. H. & P., Canada	2,000,000	100	225	226
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	97	98
Bonds, 6's	6,000,000	—	127	128
New Haven Gas Co.	5,000,000	25	182	190
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	123¾	124
1st Mortgage	20,100,000	1,000	102	102¼
2d "	2,500,000	1,000	104	—
Pacific Gas and Electric Co.	15,500,000	—	38	40
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104¾	105¼
St. Paul Gas Light Co.	2,500,000	100	—	—
1st Mortgages, 6's	600,000	1,000	104	105
Extension, 6's	600,000	1,000	113¾	115
General Mortgage, 5's	3,447,000	1,000	94	96
United Gas Imp. Co.	55,502,960	50	169	170
Washington (D. C.) Gas Co.	1,600,000	200	440	442
Western Gas Co., Milwaukee	4,000,000	—	—	—